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BIRD AND MAMMAL OBSERVATIONS AT HAZEN CAMP, NORTHERN ELLESMERE ISLAND, IN 1962*

D. B. O. SAVILE and D. R. OLIVER
Plant Research Institute and Entomology Research Institute, Research Branch, Canada Department of Agriculture, Ottawa, Ontario.

INTRODUCTION

IN 1962 THE ENTOMOLOGY RESEARCH INSTITUTE, Canada Department of Agriculture, initiated a biological study project at Hazen Camp, a station established by the Defence Research Board on the northwest shore of Lake Hazen at 81° 49′ N, 71° 18′ W. This project, largely concerned with the ecology of arctic insects, is expected to continue for several years. Oliver reached Hazen Camp on June 6 and Savile on June 16. We both left on August 23. In the course of making botanical analyses of most actual or potential study sites within several miles of camp and doing other botanical and mycological work, Savile traversed most of this area at frequent intervals and thus was able to assess the breeding bird population in some detail.

The main purpose of this paper is to present this quantitative information, which is of potential significance in the general ecological picture. Some observations were made at distances up to eight miles or more from camp, but an area of 8.6 square miles, which was covered in adequate detail, was used for the breeding census. This area, stretching from Blister Creek to Snow Goose River and from the lake shore to the steep talus of Mt. McGill, was predominantly dry ground, but included several marshes and many small ponds. Some observations were made by Oliver in 1961, but he did not arrive until July 7, and other work made detailed observations of vertebrates impossible. He did, however, secure enough hatching dates in each year to allow a comparison of the two seasons.

Behavior notes are excluded from this report, but data on several species, notably the Ruddy Turnstone and Knot, are on file in our notes.

Lake Hazen has a dry, sunny summer, with temperatures higher than at many stations 8-10° further south. This benign summer climate, which is due to the dynamic warming of winds coming over the adjacent high mountains, results in an unusually varied flora and insect fauna. Actual population densities of many organisms are, however, limited by the generally negligible summer rainfall. Mesic habitats are scarce except on springy mountain slopes. In the lowlands one passes almost at a step from marsh to semi-desert. The proportion of arid land is high, but is difficult to assess accurately, partly because of variations in the level and course of water on the extensive deltas of the glacial streams. The summer of 1962 was unusually warm, with a July mean

*An investigation associated with the program *Studies on Arctic Insects*, Entomology Research Institute, Canada Department of Agriculture (Paper No. 4).

Mailing date of this number: March 20, 1964

of 46.7°F; whereas 1961 was quite cool at Hazen, as elsewhere in the high arctic, with a July mean of 42.4°F. In 1958 the July mean was 43.8°F, which may be close to an average figure. The available data do not make it clear whether the summer temperature affected nesting success; but the late, cool season of 1961 certainly delayed nesting, as comparable figures for several species show.

For conformity with future publications, ponds are denoted by numbers allotted to them in connection with entomological studies.

BIRDS

Gavia stellata RED-THROATED LOON

One pair nested at pond 34 ("Skeleton Lake"), which was clear of ice on July 2. The young hatched on late 20 or early 21 July; both were approaching full size by August 13, although still partly downy and with short bills. A pair nested at this pond in 1961, when it became ice-free on July 16, and both young hatched on July 29 or 30. A second pair nested in 1962 much later at pond 30, two miles northeast of the first pair, the young hatching between August 5 and 10, probably about August 8 to judge from their size on August 10. This pond is about 500 feet above pond 34; it is long and narrow, and shallow at the ends. It is doubtful whether the chicks could have been fledged before it became ice-covered.

Chen hyperborea atlantica SNOW GOOSE

One to four adults were seen occasionally near camp from June 18 onward. A pair nested at pond 10, a mile north of camp, hatching five young slightly before July 17. Four young, nearly full grown, survived at the last sighting on August 20. In 1961 seen only in mid-August; definitely not breeding in study area. Tener (MS) saw young in 1958 only at the west end of Lake Hazen.

Clangula hiemalis OLDSQUAW

One or more, male and female, frequently visited pond 1, at camp, early in the summer. Two females nested in the census area, at ponds 10 and 30 (one and two miles north of camp), with broods of eight and six. Hatching dates were about July 16 for the former and probably slightly earlier for the latter. An unmated female attended the former brood until they left the home pond on August 6. In 1961 adults were occasionally at ponds 1, 10 and 34, but no young were seen. Tener (MS) noted two pairs at Hazen Camp, but no sign of nesting.

Somateria spectabilis KING EIDER

A pair were seen across the lake near Ruggles River on June 18. A pair appeared at pond 1 ("Camp Pond") on June 23. The female nested on the edge of an adjacent small pool (No. 38), hatching a brood of five on July 18. The brood was moved from pond to pond over an area of several square miles. The half-grown young often swam near the edges of ponds in shallow water with heads below the surface, apparently feeding largely on the abundant *Lepidurus arcticus*. All five young were seen on August 12, but one was lost shortly afterwards. The female and surviving four nearly grown young were seen near camp on our last day, August 23. Adults were seen at ponds in the study area in 1961, but no young were found. Tener (MS) noted the species at several places in the Lake Hazen region, but saw no evidence of breeding.

Lagopus mutus rupestris ROCK PTARMIGAN

Two pairs nested in the study area, hatching broods of eight and ten chicks before July 15. Ten fully grown young were seen as late as August 20, which may have been the residue of the two broods, for both broods seemed to have lost some members by early August. None were seen in the area in 1961. Tener (MS) saw only four birds in 1958.

Grus c. canadensis SANDHILL CRANE

Although none were seen, on June 24 the distinctive tracks of a crane (with large, straight and widely divergent toes and no mark of the hind toe) were seen in delta mud two miles southwest of camp, mixed with goose tracks. The clearest print was photographed and measured. The lateral toes were 7 and 8 cm long and the center one 10 cm long (all measurements to the mid point of the back of the impression). Mr.

W. Earl Godfrey finds the length of the center toe to be 10.0 and 10.7 cm in two mounted birds at the National Museum of Canada. The species breeds on Devon Island, so that strays may be expected in Ellesmere, although they do not seem to have been reported.

Arenaria i. interpres RUDDY TURNSTONE

This was apparently the most abundant breeding species; but only three nests were seen, and the birds often flew about in small groups rather than staying within, and declaring, their territories. One bird, surprised on the nest, gave a brief injury display; but usually there was no clear reaction to one's approach to nest or young. The number of breeding pairs in the census area was estimated to be thirty on the basis of the birds being about fifty per cent more abundant than the Knot. The numbers of young seen after mid-July suggested that this estimate was fairly reliable. Almost all broods seemed to have hatched by July 8. By August 3 almost all adults had left. A migrating flock of juveniles flew east past the camp on August 10, the voices still somewhat higher pitched than those of the adults. A few were seen at camp until August 18. Two nests were seen in 1961, both clutches hatching between July 9 and 12. Tener (MS) in 1958 first noted flying young on August 3. In 1962 a few young were just flying (and giving a high-pitched *twit-twit-twit* call) on July 20, and by July 25 most young were flying easily.

Capella gallinago COMMON SNIPE

The surprise of the season occurred on July 31 when a snipe was flushed at close range from the marshy edge of pond 34. The bill and back pattern were clearly seen, and the bird called repeatedly, eliminating any possible doubt of its identity. The site was visited daily by one or both of us in the hope of collecting the bird, but it was not seen again. Although it is probable that this bird belonged to the North American race, *delicata*, it is to be noted that the *A.O.U. Checklist* (1957) reports both *gallinago* and *faeroensis* as casual in East Greenland. The bird was presumably a wind-blown stray, possibly brought in on the gale of July 23. This occurrence makes somewhat more plausible the record from Repulse Bay, which Snyder (1957) treated with understandable misgiving.

Calidris c. canutus KNOT

In June and early July the birds spent much time circling and calling at up to more than 1000 feet, singly or in small groups, making the location of territories difficult. After about July 5, as the eggs were beginning to hatch, territories were readily marked by the birds giving continuous alarm notes at one's approach. Within a few days, as the young began to move about freely, "rodent run" distraction displays were performed long before the young could be seen, greatly helping in the counting of broods. Twenty pairs estimated to have bred in the census area. By August 1 most young were independent, although an adult was found guarding a single late chick, still partly downy, on August 11. Most birds had left by August 6. A flock of more than seventy-five passed northeast over the camp on August 5, suggesting that this population flies north of the Greenland ice-cap to northwestern Europe. Young were first seen in 1961 on July 9.

Erolia bairdii BAIRD'S SANDPIPER

Single birds were seen on June 18 and 19. A few were seen with other waders at a pond behind a barrier beach on June 24; and two were seen at the same place on June 28. None bred in the study area, however, despite suitable marshes; and the species was next recorded on August 6 when two flew overhead, calling. Three were seen at Blister Creek delta on August 9, and eight on August 11. Tener (1961) records an adult with a chick a mile north of Hazen Camp.

Crocethia alba SANDERLING

First definitely seen on June 21. First indication of breeding was obtained when a pair gave "rodent run" displays on June 25 at the Snow Goose River delta 1½ miles northeast of camp. Four scattered pairs nested in the study area on sandy or gravelly sites near the lake shore. Young barely flying were seen near camp on August 3. Last seen on August 11, but work at camp prevented later observations at favored sites. Tener (MS) noted an adult with four small young on July 30, 1958 at Blister Creek, where one of the 1962 pairs nested.

Stercorarius longicaudus LONG-TAILED JAEGER

Six pairs nested in the census area. Eggs hatched between July 9 and ca 12. Both eggs hatched in each nest, the second often a

full day after the first. With lemmings very scarce, the adults took appreciable numbers of young Knots and Ruddy Turnstones. In most pairs of young marked size differences were soon apparent, the smaller one evidently failing to survive more than two weeks. Presumably, with food scarce, the stronger chick obtained most of what the parents brought in. This behavior may be adaptive, for equal division of the food might have left both chicks undernourished and incapable of flying before cold weather set in. One half-grown chick walked out on brash ice at the lake edge in search of insects, slipped through and drowned. The most advanced young started to fly about August 3. Most flew strongly by August 11, although the parents were still moderately attentive. Several birds were still about the camp on August 23. In 1961 no nests or young were seen and Oliver was subjected to no attacks, which suggested absence of breeding in the camp area. It is not clear whether the relatively late spring or the almost complete lack of lemmings was responsible for this breeding failure. Although the summer was a cool one, it was still much warmer than that at Isachsen in 1960 where the species nested successfully when lemmings were plentiful. However, delayed snow-melting in spring might make nesting impossible until the birds were past breeding condition. Lemmings were still scarce in 1962, but evidently more abundant than in 1961. Tener (MS) noted some nesting in 1958, despite a scarcity of lemmings.

Larus hyperboreus GLAUCOUS GULL

Single adults were seen on June 19, June 24 and July 13. No good nest sites occur close to Hazen Camp. Oliver saw no birds after his arrival in July 1961, but other members of the party reported several in June. Tener (MS) saw several in 1958 but had no evidence of breeding.

Sterna paradisaea ARCTIC TERN

First seen on June 16. One pair nested on a sandy point near camp and a second on a similar site two miles southwest. Both eggs of one nest hatched between July 13 and 16. The first egg in the second nest hatched on July 17 and the second a day or so later. All four young were raised successfully, starting to fly about August 8. Last seen by P. S. Corbet on August 19. In 1961 there was a nest on the sandy point near camp, in which the eggs hatched on July 30. In 1958 Tener (MS) saw flying young on August 1, which indicates an early nesting.

Nyctea scandiaca SNOWY OWL

Not seen in 1962. In 1961 one was seen on August 15, flying south near Hazen Camp. Tener (MS) saw widely scattered individuals in 1958, but no evidence of breeding.

Acanthis h. hornemanni HOARY REDPOLL

Date of arrival uncertain but evidently early. Flying young were seen on June 27, still attended by parents. Young and adults were seen up to over 2500 feet on Mt. McGill on June 29. On July 5 a flock of about fifteen seemingly independent young was seen at the foot of Mt. McGill talus. An adult seen closely on July 17 was evidently molting into winter plumage. Most had left by July 31, but one was seen on August 4. One pair nested in a hummocky *Dryas*-covered gully near camp. All other nests were apparently in crevices of the talus slope of Mt. McGill. Parmelee and MacDonald (1960) found the species nesting in this habitat in the Eureka Sound area. Twelve breeding pairs were estimated for the census area.

Calcarius l. lapponicus LAPLAND LONGSPUR

A single male was seen briefly in a gully near camp on July 20. It gave a two-noted call several times, but did not sing. Definitely did not breed in or near the study area in 1962, but Tener (1961) records a female feeding a single flightless juvenile three miles northeast of camp in 1958. In 1961 a single male was seen a few miles west of camp, up Blister Creek, on August 5.

Plectrophenax n. nivalis SNOW BUNTING

Evidently arrived early but did not nest as promptly as the Hoary Redpoll. Crevices in the talus slope were the preferred nest sites; but a scattering of nests occurred in mud cracks and other cavities in the alluvial lowlands. One nest near camp was in the slightly enlarged entrance of a lemming burrow. The eggs in this nest hatched on July 2. Within a few days adults were seen carrying food into several cavities, indicating that this was a representative hatching date. The young from the lemming burrow nest flew on July 13. By late July flocks of juveniles occurred increasingly around the camp, seemingly attracted as much by cover as by food. By August 15 some young were nearly into

winter plumage, but others were still very gray. A few were seen as late as August 18. A nest found on July 13, 1961 contained five nearly fledged young; and young were flying on July 16. In 1958 Tener (MS) noted migrating flocks passing through camp from August 15 to 20. In 1962 it was estimated that twenty-five pairs nested in the census area.

BREEDING BIRD DENSITY

It was estimated that in 1962 there were, in all, 107 breeding pairs of birds in the study area of 8.6 square miles. This figure yields a density of 12.5 pairs per square mile, 1.94 pairs per 100 acres, or 0.39 individuals per 10 acres. This is about 2.5 times the density found for a colder and much more sparsely vegetated area at Isachsen (Savile, 1961); but it is about 1/10 to 1/20 of various estimates published for low-arctic tundra (Hickey, 1943; Savile, 1951). It is also appreciably lower than rough estimates (Savile, 1959, p. 961) for all but the most sterile parts of Somerset Island, which has a lower summer temperature and a somewhat smaller flora than Lake Hazen. It appears that the extreme aridity of many sites at Hazen Camp must markedly limit the breeding population, by restricting plant growth and, consequently, insect abundance.

It is perhaps significant that the Turnstones, Knots, Sanderlings and Snow Buntings fed extensively in July and August on chironomid midges, which were washed ashore and on to the melting ice of Lake Hazen. The lake is perhaps an important source of food in this arid region. It is possible that far from the lake the breeding density would have been substantially lower.

MAMMALS

Alopex lagopus ARCTIC FOX

An adult was seen on July 3 being chivied by a pair of jaegers near Blister Creek. On July 8 a den was found, four miles from camp, with two well-grown cubs. By July 30 the cubs had left the den, but one was seen a few hundred yards away. The den is evidently very old, with twenty-two openings in an area 24 x 18 feet.

Canis lupus WOLF

One, or at most two, were seen near camp periodically in June and early July; and fresh tracks were often seen, once right through camp. One was evidently attracted, like the jaegers, by food scraps. In 1961 wolves were much commoner locally, as many as six often being seen around camp. On August 19, 1961 two dead wolves were found between camp and the Snow Goose delta. Both had died recently and had clearly been gored by musk-oxen. Tener (MS) saw eleven near camp in May 1958, but saw few in the region during the rest of the summer.

Mustela erminea ERMINE

Apparently very scarce. None was actually seen, but on August 4 R. B. Madge found fresh remnants of a lemming deep in a burrow. Typical, fresh and reasonably clear tracks were seen in dry sand near camp on August 10. Tener (MS) found the species scarce in the region in 1958.

Lepus arcticus ARCTIC HARE

One to three adults were seen periodically on the slopes and gullies of Blister Hill near the camp. P. S. Corbet saw two adults, presumably different animals, two-thirds up the northeast slope of Mt. McGill. On August 20 Corbet saw three playing on a ridge near camp that may have been young, but no definite proof of breeding was obtained. In summer the hares tend to feed on the tops of tall grasses and other herbs in the gullies. They spend enough time in some favored spots to cause local nitrification and lush growth in gullies where moisture is not a limiting factor. In one such spot *Poa hartzii*, which usually has the aspect of a typical desert bunch-grass with glaucous and involute leaves, had flat, green leaves and a lax habit, and somewhat resembled *P. arctica*. In 1958 Tener (MS) found hares widespread but not numerous and saw no sign of breeding.

Dicrostonx groenlandicus COLLARED LEMMING

None were seen in 1961. Recovery from the crash had evidently started in 1962. J. A. Downes saw two in early July, and R. B. Madge saw one taken by a jaeger on July 9. W. H. Forrest caught a juvenile in late July. We saw a dead juvenile at the fox den on July 30. Oliver caught a small juvenile on August 12 and Savile saw another. Thus all those seen closely were juveniles, indicating active breeding. Tener (MS) indicates a peak in 1957, a crash in the succeeding winter, and great scarcity in 1958.

Rangifer tarandus CARIBOU

None were seen near the camp in 1961 or 1962 and all shed antlers examined were quite weathered. The species does occur in the Lake Hazen valley, however, for Tener (MS) saw one at the camp and one eight miles north, and reports that R. L. Christie saw four about thirty miles east of the lake.

Ovibos moschatus MUSK-OX

One or occasionally two bulls periodically appeared near camp during the summer, but the cows and calves generally remained some miles off on the mountain slopes, where small groups were occasionally seen. In mid-August, as snow cover increased on the mountains, more animals appeared in the lowlands. The highest count was obtained on August 20 when fourteen adults and six calves were seen within a mile of camp. Tener (MS) recorded a total of eighty-six animals in the lake region in 1958.

PREDATION

The scarcity of lemmings in 1962 unquestionably diverted predation against some species of birds to an appreciable extent. The Long-tailed Jaegers certainly took substantial numbers of young Knots and Ruddy Turnstones (perhaps nearly twenty-five per cent of the total) and at least one adult Knot. The effects of foxes, wolves and ermine were much less apparent, but were probably appreciable. None of these mammals were abundant enough to exert an overwhelming effect; and there was no such disastrous nesting failure as MacDonald (1961) reported for Ellef Ringnes Island when lemmings were scarce. A possible reduction of young ptarmigan in the census area from eighteen to ten in a month was, if actual, the most severe loss of predation. One young out of five was lost by both the Greater Snow Geese and King Eiders. Loss, if any, by the Oldsquaws was light despite several long marches from pond to pond. The substantial loss of Long-tailed Jaeger chicks seems to have been due more to starvation and accident than to predation. The wolf seemed little disturbed by the attacks of the jaegers and terns, and was a potentially successful predator against these species although all tern chicks in our area were fledged successfully. The fox seen was so terrified by the attacks of the jaegers that it was probably ineffective against the young of this species or the terns. The foxes may have raided some nests of Knots and Ruddy Turnstones. Most nests of Hoary Redpolls and Snow Buntings were safe from any predator but an ermine.

With both greater diversity of species (1.5:1) and a greater density (2.5:1) of breeding birds at Hazen Camp than at Isachsen (Savile, 1961), it is possible that predation does not fluctuate as violently; but many more observations are needed before any positive conclusions can be drawn.

It seems remarkable that the carnivores were able to survive the winter at Lake Hazen with lemmings so scarce. The foxes certainly take a few hares (one hare foot was seen at the den). The wolves pull down an occasional isolated musk-ox, with some casualties to themselves. The foxes scavenge the

musk-ox carcases, for bones of various ages are to be seen at the den. Whether the ermine also scavenge the carcases is not known.

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PSEUDOFOSSILS NEAR OLD CHELSEA, QUEBEC

Donald D. Hogarth
Department of Geology, University of Ottawa, Ottawa, Ontario

The problem of evidence of life in rocks of Precambrian age has long been of interest to geologists. In Quebec the subject was introduced when J. W. Dawson (1865) described *Eozoon canadense* from a locality thirty-five miles northeast of Ottawa. Vigorous discussions ensued for a number of years on the status of this structure but today few geologists believe that *Eozoon* is of organic origin.

Recently structures superficially resembling the larvae of monarch butterflies and others resembling crinoid stems were discovered during geological mapping. These structures are composed of fine-grained quartz (jasper or chalcedony) at two localities (Figure 1): a single occurrence on the Gatineau Parkway about 1½ miles southwest of Old Chelsea and a group of occurrences centred about one mile north northeast of Old Chelsea

Jasper and chalcedony occur in a variety of rocks (Figure 1). The most common types are feldspathic quartzite, biotite gneiss, marble and calc-silicate rocks derived from marble. The calc-silicate rocks include the well-known metamorphic pyroxenite of the Ottawa Valley, quartz-tremolite, quartz-dopside and calcite-pyroxene varieties. Jasper also is found in pegmatite on the Gatineau Parkway near the Dunlop Road and in talc-rich quartzite on the Chelsea Brook a mile south of Chelsea. It may be significant that, only those occurrences with chalcedony or jasper in marble or calc-silicate rocks disclosed organic-like textures.

Parkway Occurrence

During the construction of the Gatineau Parkway a chalk-white mineral was revealed in a rock-cut about 2300 feet south of the Kingsmere road. The exposure is now covered with earth. The mineral occurred in a mica vein and was shown by X-ray diffraction to be fine-grained quartz (chalcedony). Another mica vein, about a mile northeast, held a mineral of similar appearance but which, on examination, proved to be feldspar (microcline).

Masses of chalcedony were found in veins which cut metamorphic pyroxenite. The pyroxene has been largely altered to coarse-grained actinolite. The chalcedony occurred principally in two places about fifteen feet apart and in masses two feet across. It is found with relatively coarse-grained quartz and plums of pink barite. Orange jasper was occasionally seen as small isolated flecks in chalcedony.

Under the microscope the chalcedony was observed as concentric bands and whisps. It was white in reflected light but brown to transmitted light. Coarse quartz occurred in interstices but sometimes within the chalcedony masses. The unusual crinoidal or worm-like shapes were often seen in this

FIGURE 1. Map of the Old Chelsea district showing generalized geology and occurrences of jasper and chalcedony.

rock. Associated minerals were phlogopite, sphene, apatite, pyrite, hematite, tourmaline, calcite, chalcopyrite and molybdenite.

Various stages of replacement of mica (phlogopite) by quartz have been observed. Initially chalcedony entered between sheets of phlogopite causing exfoliation (Figure 2a). This was apparently accomplished without loss of birefringence in the mica and therefore without vermiculitization. Then comparatively coarse quartz replaced phlogopite. Some partially replaced sheets have been seen. At a more advanced stage phlogopite may have been completely replaced producing the segmented shapes illustrated in Figure 2b. Finally barite and a little calcite filled the open spaces and replaced some of the worm-like structures leaving only traces of the original forms.

Occurrence North of Old Chelsea

Jasper has long been known at the Scott Mine just west of the Tenaga road (Figure 1). Textures and mineralogy have been described by Hannah (1952), Tanton (1953) and Hogarth (1962). Recent work by the writer has shown that the jasper occurrences are distributed throughout an area at least 1400 feet wide and 3500 feet long.

Spheroidal structures similar to those described by Hannah and Tanton were seen at most occurrences. These were often composed of radiating individuals occasionally showing concentric zones rich in dusty hematite. Sometimes jasper has been fractured and a later generation of quartz or chalcedony was deposited in voids (Figure 2c). This late quartz seems to be free of hematite. Other late vein-forming minerals are calcite, barite, fluorite and sphalerite.

Segmented worm-like shapes were found in most deposits in marble or calc-silicate rock (Figure 1). A complete series of stages of development was observed identical to that described from the Parkway occurrence. Well-formed quartz pseudomorphs after phlogopite were observed in "worms" at occurrence No. 4.

Morphology of pseudofossils

The size of these forms varies considerably. The largest is 4 inches long and 0.7 inches wide (occurrence No. 2). Most are less than ½ inch long. An average length-to-width ratio of 8 well-formed specimens is 6.4:1.

FIGURE 2a. Photomicrograph in polarized light of mica (light grey in centre of photograph) exfoliated and filled with chalcedony (dark grey). Locality No. 1.

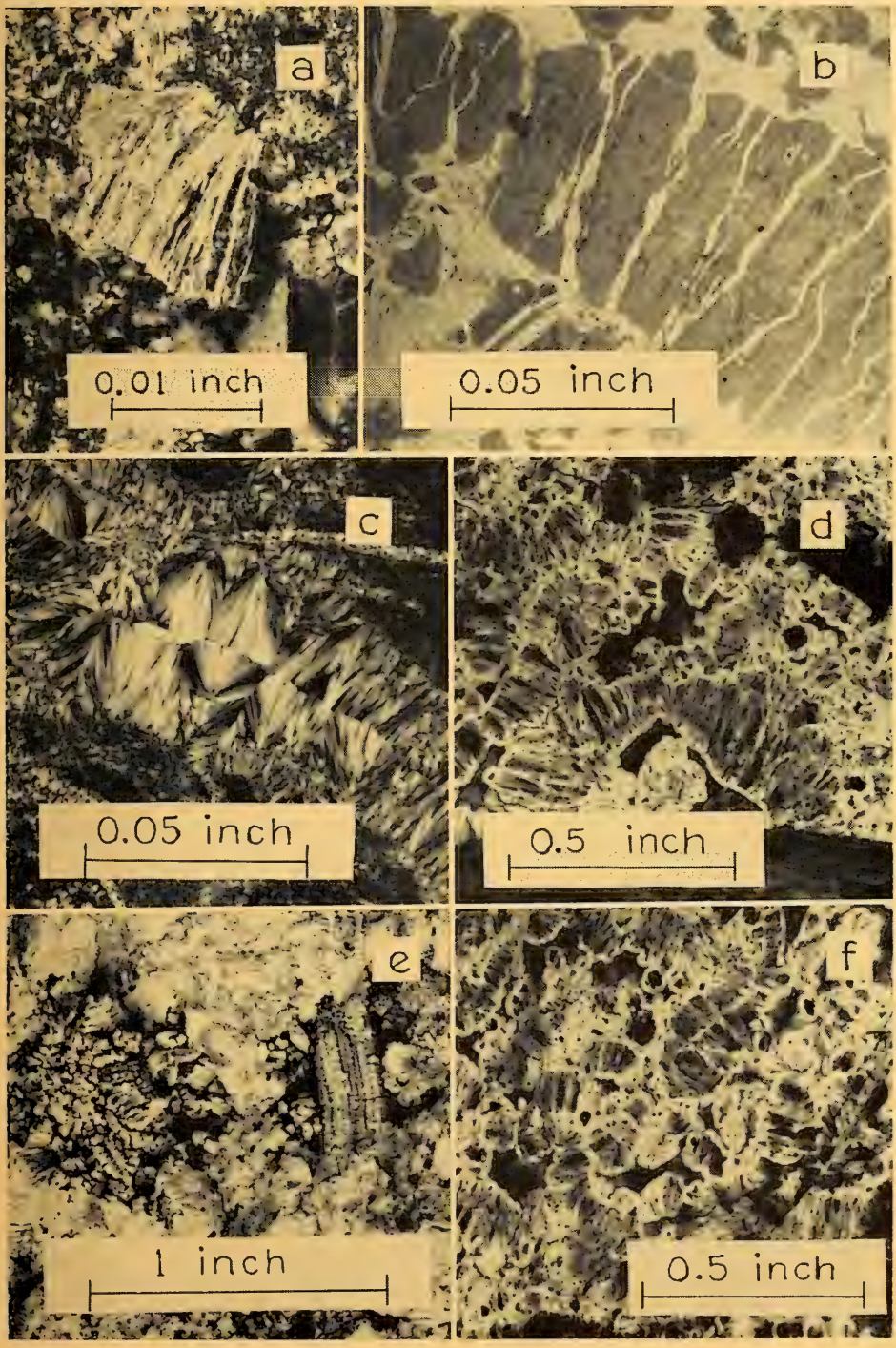
b. Photomicrograph in ordinary light of a worm-like structure composed of chalcedony and quartz (dark grey). A later generation of quartz (light grey) veins and surrounds the structure. Locality No. 1.

c. Photomicrograph in polarized light of a typical veinlet of late chalcedony. Locality No. 3.

d. Coiled and segmented structures of chalcedony. Black patches are cavities partially filled with barite. Photograph of a freshly broken surface from locality No. 1.

e. Ribbed "crinoidal" growths of chalcedony in cavities. Locality No. 1.

f. Pairs of replaced mica "books" enclosing a layer of white chalcedony which simulates the digestive tract of an organism. Photograph of a freshly-broken surface from locality No. 1.


a
0.01 inch
b
0.05 inch
c
0.05 inch
d
0.5 inch
e
1 inch
f
0.5 inch

In outline the structures show certain regularities. Most specimens taper at both ends although a few are abruptly terminated. Some are distinctly coiled (Figure 2d). This is especially true of larger individuals which, in rare instances, turn through a complete circle. They do not appear to be branched or intertwined.

External forms are often well-developed on individuals in cavities (Figure 2e). Sharply-divided segments of the type described above are common. In addition individuals may be roughly hexagonal in cross section but distinctly ribbed along their length. This ribbing is presumably due to groups of parallel crystals continuous along the prism axis. Similar composite crystals may be seen in unaltered phlogopite in many places in the Old Chelsea district.

Pairs of parallel, replaced mica books may only be separated by a narrow layer of chalcedony simulating a digestive tract in long section (Figure 2f). In cross section the "worms" are structureless.

Summary of Origin

Worm-like forms at both the southern and northern localities appear to have originated in the following manner.

1. Siliceous dolomites were metamorphosed to calc-silicate rocks composed of pyroxene, phlogopite and calcite. Rocks were intensely deformed at a temperature of about 1100°F and a pressure of 100,000 pounds per square inch. It is unlikely that any fossils could have survived these conditions.
2. Chalcedony or jasper penetrated between sheets of mica causing exfoliation. Textures suggest that this silica was deposited as a gel at low temperature (Hannah, 1952).
3. Mica was replacd by quartz containing only small amounts of iron oxide. The resulting structure simulated a segmented organism. A later generation of chalcedony may have been added at this stage.
4. Jasper was cut by calcite-barite veins locally carrying quartz, fluorite, chalcopyrite and sphalerite.

One may theorize on the date of the jasper and calcite-barite mineralization. Calcite and barite are known to be late in the geological sequence in this region. Veins of barite cut all Precambrian formations. They even fill breccias in Paleozoic limestones just south of Fairy Lake and 1000 yards southeast of the intersection of the Notch and Mountain Roads. In the localities considered the calcite has not reacted with quartz and therefore may postdate the regional metamorphism. It is thus possible that calcite-barite and the associated jasper are not older than Ordovician.

Acknowledgments

The pseudofossils were discovered in 1961 during geological mapping sponsored by a grant from the Geological Society of America. Professor D. M. Baird of the University of Ottawa and Dr. D. J. McLaren of the Geological Survey of Canada kindly read the manuscript and made helpful suggestions.

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BIRDS OF KLEENA KLEENE, CHILCOTIN DISTRICT, B.C., 1959-1962

W. ADRIAN B. PAUL
Kleena Kleene, British Columbia

THE FOLLOWING LIST supplements the paper published previously by the writer (Paul, 1959). It adds 38 species to the list and gives additional information on 35 others.

Phalacrocorax auritus DOUBLE-CRESTED CORMORANT. May 17, 1960, one reported, twice seen on float on One Eye Lake.

Anas carolinensis GREEN-WINGED TEAL. Breeds. July 27, 1960, six young two weeks old near Nimpo Lake. August 8, 1962, six young three-quarters grown.

Anas discors BLUE-WINGED TEAL. Probably breeds. May 6 1962, one pair; May 13, 1962, three pairs; May 25, 1961, six pairs in a flock; June 7, 1962, one pair; June 13, 1962, one pair; June 17, 1961, four males and three females.

Anas cyanoptera CINNAMON TEAL. Probably breeds. May 16, 1962, two pair; June 8, 1961, one pair; June 20, 1962, one pair.

Spatula clypeata SHOVELER. Probably breeds. May 15, 1961, one pair; May 30, 1962, one pair and one male; June 8, 1961, two male and one female; August 28, 1961, three seen.

Aythya valisineria CANVASBACK. Breeds. May 6, 1962, eight males and some females; May 20, 1962, three pairs; June 7, 1962, one female; July 27, 1960, downy young near Nimpo Lake.

Melanitta deglandi WHITE-WINGED SCOTER. *M. perspicellata* SURF SCOTER. These are migrants and may be seen from time to time in spring and early fall on Clearwater Lake, in flocks up to about thirty. The two species are sometimes difficult to distinguish at a distance. April 29, 1961 and May 16, 1962, one pair of Surf Scoters. October 25, 1960, three White-winged.

Oxyura jamaicensis RUDDY DUCK. Breeds. May 6, 1962, four males and some females; June 17, 1961, four males and one female; June 13, 1962, six males and two females; July 7, 1962, one pair; July 27, 1960, seven downy young near Nimpo Lake.

Accipiter gentilis GOSHAWK. Breeds. July 5, 1959, three fledglings; May 7, 1960, one

seen; September 10, 1960, September 12, and October 10, 1962, one immature.

Accipiter striatus SHARP-SHINNED HAWK. Noticed only in the fall. August 27, 1961; October 12, 1962; and October 26, 1960, one mature seen; September 15, 1962, one immature.

Accipiter cooperii COOPER'S HAWK. July 31, 1962, and August 4, 1962, one mature seen; August 17, 1962, one immature.

Buteo jamaicensis RED-TAILED HAWK. Migrant. May 14, 1960; May 18, 1962, and May 28, 1961, one seen; August 4, 1962, one sitting on a haycock.

Buteo swainsoni SWAINSON'S HAWK. Believed seen on May 17, June 24 and September 26, 1961.

Falco peregrinus PEREGRINE FALCON. Migrant. May 2, 1962; May 3, 1961; May 5, 1960; September 6 and October 10, 1962, one seen.

Falco columbarius PIGEON HAWK. Noticed several times in spring of 1961. April 29, one pair, observed to mate; May 4, one seen; May 27, one pair.

Porzana carolina SORA. May 13, 1962, one seen, confirming information by long-time residents that this species seen or heard occasionally.

Charadrius vociferus KILLDEER. Regular summer residents. Eggs laid in early June. June 8, 1959, four eggs near Tatla Lake.

Capella gallinago COMMON SNIPE. Arrive in April. Mating displays through May and June. July 10, 1959, a flock of eight in a barnyard; July 18, 1962, three flying in a flock.

Actitis macularia SPOTTED SANDPIPER. Common summer resident. Eggs hatch in early July. July 14, 1961, one-third grown.

Erolia minutilla LEAST SANDPIPER. August 6, 1962, six feeding in a flock; August 29, 1962, one seen.

Ereunetes mauri WESTERN SANDPIPER. August 15, 1962, twenty-five feeding in a flock; August 22, 1962, twelve feeding in a flock; August 29, 1962, six seen.

Steganopus tricolor WILSON'S PHALAROPE. Present from late May to October. Breeds. June 17, 1961, three males and three females. Distraction displays June 17, 1961; July 19, 1961; July 11, 18 and 25, 1962. August 4, 1961, three seen in a flock. August 22, 1962 and October 14, 1961, one seen.

Larus californicus CALIFORNIA GULL. July 19, 1962, one mature and one second year seen.

Chlidonias niger BLACK TERN. Estimated numbers of pairs nesting at Brink Ranch at Kleena Kleene, twenty-five pairs in 1961, fourteen pairs in 1962. First young seen in flight in 1961 on July 19, in 1962 on July 18. On three occasions, late July and early August, seen carrying fish.

Zenaidura macroura MOURNING DOVE. May breed at Dowling Ranch; June 4, 1961, two seen; September 13, 1961, one mature and two immature (short tails).

Bubo virginianus GREAT HORNED OWL. Breeds. Seen or heard in every month of the year. June 4, 1962, two fledglings.

Glaucidium gnoma PYGMY OWL. June 13, 1962, one found dead, completely dehydrated, confirming local information to effect that they are present (both summer and winter), and sometimes die of starvation.

Asio otus LONG-EARED OWL. May 18, 1961 and September 14, 1961, one seen.

Selasphorus rufus RUFOUS HUMMINGBIRD. Present May through August. Males last seen June 22, 1961; females last seen September 1, 1960; August 24, 1961, one female with one immature.

Stellula calliope CALLIOPE HUMMINGBIRD. Males observed at three locations between May 30 and June 20, 1961; and at two locations between June 6 and 19, 1962. Undoubtedly nesting.

Sayornis saya SAY'S PHOEBE. April 29, 1961, one seen.

Empidonax trailii TRAILL'S FLYCATCHER. Breeds. Sings during June and July. Last seen September 2, 1962.

Empidonax minimus LEAST FLYCATCHER. Believe one seen May 20, 1961.

Empidonax hammondii HAMMOND'S FLYCATCHER. Breeds. Heard and seen during June and July. Young left a nest on July 22, 1962.

Empidonax dificilis WESTERN FLYCATCHER. Are usually represented locally and appear to breed but were noticably absent in 1962. May 20, 1961, one seen. September 9, 1961, one seen.

Contopus sordidulus WESTERN WOOD PEWEE. Arrives about mid-May. Breeds.

Nuttallornis borealis OLIVE-SIDED FLYCATCHER. May breed. June 12 and 18, 1962, one seen; August 6 and 11, 1962, one seen; August 19, 1962, two seen.

Eremophila alpestris HORNED LARK. Usually a flock of about two hundred present in early May. The flock breaks up and all individuals disappear before the end of the month. Never noted in the fall by this observer.

Tachycineta thalassina VIOLET-GREEN SWALLOW. Begin to arrive about mid-April and stay about three and a half months. Egg laying dates vary. A few hatch around June 1, while others are still feeding nestlings up to the last week of July. All disappear in early August.

Iridoprocne bicolor TREE SWALLOW. Arrive in second half of April, usually hatch about mid-June. During August they move about in flocks and are usually last seen in early September. September 30, 1962, three seen.

Riparia riparia BANK SWALLOW. Arrive in late April and some start to lay a month later. Nesting is usually completed about end of July, after which they are seen no more.

Stelgidopteryx ruficollis ROUGH-WINGED SWALLOW. Arrival and nesting dates are the same as for Bank Swallows. They are less plentiful than any local species except the Barn Swallow.

Hirundo rustica BARN SWALLOW. Arrive in early May and stay about four months; may often be seen about September 1 in company with Tree Swallows. June 23, 1960, a nest with one egg; August 29, 1962, fledglings being fed by parents; September 12, 1962, two seen.

Petrochelidon pyrrhonota CLIFF SWALLOW. Arrive about the same time as Barn Swallows. Mostly they build under the roofs of barns or other buildings but small colonies may be noted on cliffs. If all goes well they hatch about the end of June but where nests collapse there may be hatches late in July. All go south in August.

Troglodytes troglodytes WINTER WREN. Present in April and September but observed at no other time.

Hylocichla guttata HERMIT THRUSH. June 12, 1962, one seen.

Hylocichla ustulata SWAINSON'S THRUSH. May breed. Seen June 1, 1962; June 18, 1962 a pair; June 30, 1961 a pair; July 17, 1962.

Hylocichla fuscescens VEERY. Breeds. Singing from mid-May until end of June. July 16, 1962 a fledgling seen that was being fed by a parent.

Anthus spinoletta WATER PIPIT. Flocks up to fifty present at 3000 feet throughout May and often seen in September. August 1, 1962 a few seen including immatures.

Lanius excubitor NORTHERN SHRIKE. Single birds observed in April and October only. October birds sometimes immature plumage.

Sturnus vulgaris STARLING. Locally little increase during past few years. June 20, 1962 young left nest in woodpecker cavity. October 3, 1962, forty in a flock.

Vireo olivaceus RED-EYED VIREO. Migrant. Noted for first time in 1962. June 16, one singing; and June 17 in same location two, both singing about fifty feet apart; June 21, one singing about eight miles from above.

Vireo philadelphicus PHILADELPHIA VIREO. May 31, 1962, one of this species believed seen and heard.

Vireo gilvus WARBLING VIREO. Sings throughout June. July 2, 1959, a nest with young; July 27, 1960, seen carrying food. August 25, 1962 one seen.

Vermivora celata ORANGE-CROWNED WARBLER. Are here singing at end of April and may be seen feeding amongst aspen catkins

in early May, in association with kinglets and/or chickadees. Singing continues until early July. Southbound migration apparently starts in mid-August. Last seen August 11, 1959; September 6, 1958.

Dendroica petechia YELLOW WARBLER. Arrive in mid-May and sing during May and June; their numbers vary considerably from year to year. Very seldom seen later than July. September 2, 1962, one seen.

Dendroica magnolia MAGNOLIA WARBLER. Observed only once. Seen and heard singing June 25, 1959. Believe heard once in 1960.

Dendroica auduboni AUDUBON'S WARBLER. Arrive in second half of April. Singing is heard intermittently until July. Flocks up to twenty may be noted throughout September.

Dendroica townsendi TOWNSEND'S WARBLER. Migrant. Single birds noticed June 3, 1962; June 16, 1962; August 18, 1961; August 20, 1961. September 8, 1959, six seen.

Seiurus noveboracensis NORTHERN WATERTHRUSH. Arrive the last week of May and continue to sing through June. August 18, 1962, one singing.

Oporornis tolmiei MACGILLIVRAY'S WARBLER. Arrive last of May and sing until mid-July, remaining in vicinity until mid-August.

Geothlypis trichas YELLOW-THROAT. Arrive about May 25 and sing well into July. July 21, 1957, a fledgling just left nest. Not plentiful.

Wilsonia pusilla WILSON'S WARBLER. Usually arrive early May and sing until about June 1. After end of June are not seen until fall migration in mid-August.

Setophaga ruticilla AMERICAN REDSTART. Arrive at end of May and sing for about three weeks, remaining in vicinity until end of August.

Xanthocephalus xanthocephalus YELLOW-HEADED BLACKBIRD. Estimated thirty pairs nesting at Brink Ranch in 1961 and 1962. First fledglings observed June 17, 1961 and June 27, 1962.

Molothrus ater BROWN-HEADED COWBIRD. Immature birds often seen with livestock in July and August; July 25, 1960 a fledgling; July 4, 1961 a fledgling about a week from nest.

Hesperiphono vespertina EVENING GROSBEAK. Rarely seen. April, 1960, twelve reported; October 13, 1959, six seen.

Carpodacus mexicanus HOUSE FINCH. Single pairs present and singing on at least two occasions during first half of June 1961. None seen in 1962.

Spinus pinus PINE SISKIN. Small flocks noted throughout the summer; indications of nesting very slight. September 12, 1962, sixty seen. October 13, 1962, ten seen.

Passerculus sandwichensis SAVANNAH SPARROW. Breeds. May 6, 1961, eight seen; May 25, 1961, forty seen; October 10, 1962, thirty seen.

Zonotrichia leucophrys WHITE-CROWNED SPARROW. Breeds. Sings from arrival in late April until July, sometimes August. A flock of twenty-five immature plumage seen at Tatla Lake Septmeber 28, 1960.

Passerella iliaca FOX SPARROW. September 23, 1961, one found dead.

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TERRITORIALITY AMONG WINTERING SNOWY OWLS

Lloyd B. Keith
Department of Wildlife Management, University of Wisconsin

This paper is primarily concerned with territorial behaviour of some Snowy Owls, *Nyctea scandiaca*, which spent the winter of 1960-61 at Horicon Marsh, Wisconsin. My observations began on November 18 when the first bird was seen; and field work was terminated on April 15 when a thorough coverage of the Marsh by boat confirmed that the owls had departed. The Horicon data will be augmented to a limited extent by observations made elsewhere in southern Wisconsin during the same period.

I should like to acknowledge the invaluable assistance of Frederick and Frances Hamerstrom, D. D. Berger, and H. C. Mueller who introduced me to the art of owl trapping, and who initially caught three of the six birds that were later kept under close scrutiny. I am grateful also to H. A. Mathiak and others who contributed sight records of marked owls. R. A. McCabe and J. T. Emlen read the manuscript and made helpful suggestions and comments.

Methods

Through the fortunate combination of an early freeze-up and little snow, all parts of the 30,000 acre Horicon Marsh were accessible by truck from the third week of December until the last week in February. During January-February, at least one full day each week was spent on the Marsh trapping and observing Snowy Owls. Owls were live trapped with a bal-chatri (Berger and Mueller, 1959; Berger and Hamerstrom, 1962), using starlings, *Sturnus vulgaris*, and pigeons, *Columba livia*, as bait (Figure 1). A quick-drying aerosol paint (Blair "Spray-Hue") was utilized for colour marking; it proved convenient and effective.

Territorial Behaviour

The early works of Manniche (1910) and Pleske (1928), and the more recent studies of Pitelka *et al.* (1955), Sutton and Parmelee (1956), Watson (1957) and Hagen (1960) have provided a wealth of data on the breeding biology and nesting behaviour of the Snowy Owl. However, information concerning wintering populations of this species in southern Canada and the northern United States is largely confined to (1) the periodicity of major invasions, (2) estimates of numbers and distribution of individuals involved, and (3) food habits (see Deane, 1902, 1907; Gross, 1927, 1931, 1944, 1947; Snyder, 1943, 1947, 1949; and others). Relatively little is known about the sex and age structure, movements, and behaviour of such populations.

Perhaps one of the earliest comments about wintering Snowy Owls restricting themselves to a specific area was made by Hicks (1932) who stated: "In

1930-31 a large number of the records listed were of birds reported to have been present in some particular locality for from two to nine weeks. . . ." Meade (1948) likewise declared: "There is evidence . . . that once incursive birds have reached a certain locality they tend to remain there for extended periods." His correspondents had noted two owls remaining for forty-one days, two others for approximately seventy-five and ninety days, and a fifth which was shot after ninety-eight days. Referring to two Snowy Owls that had wintered on an Ontario farm, Mitchell (1947) wrote: "All winter they have had quite well defined territories about half a mile apart. . . ." Keith (1960), working in Manitoba, maintained: "Soon after Snowy Owl observations began at Delta, it became apparent that some birds had settled in the district and were restricting their daily movements to rather limited areas which I have interpreted as hunting ranges."

The first account of territorial behaviour (in the sense of defending an area) among wintering Snowy Owls seems to be that given by Gillese (1960) in a popular article describing the work and observations of A. Oeming of Edmonton, Alberta: "A Snowy Owl doesn't even like another Snowy invading its territory. Four times, from a ringside seat in the snowdrifts, Al has seen two birds do battle — swooping low, then suddenly rising high, bodies crashing in mid-air. . . ."

Ten owls were caught and colour-marked at Horicon Marsh during the present study. Four of these, along with two untrapped but easily recognized individuals, were repeatedly noted on the Marsh and provided most of the information on territoriality. The unmarked birds were a large darkly barred female, and a small very white male. All but three of the ten colour-marked owls were reobserved at least once.

The distribution of sight records of six Snowy Owls (Figure 2) strongly implies that mutually exclusive territories had been established. That these were indeed defended areas is indicated by the following witnessed conflicts — seemingly provoked by the presence of our baited traps:

(1) January 14: At 4 p.m. a trap was set out on the Main Ditch between, and in full view of two birds, *All Blue* and *Dark Unmarked*. They were about three-quarters of a mile apart at the time. Within a few minutes, *Dark Unmarked* flew northward and alighted beside the trap. *All blue* then immediately flew south towards *Dark Unmarked*, uttering a high piercing cry. *All Blue* alighted on the ditch about 200 yards from *Dark Unmarked*, who responded by flying towards *All Blue* and alighting about thirty yards from her. *All Blue* immediately flew back northward to her initial perch, and *Dark Unmarked* returned to the trapsite.

(2) January 21: A trap was placed near *Light Unmarked* at 5 p.m. After approximately half an hour, he flew over and landed beside the trap. About a minute later *Light Unmarked* suddenly flew rapidly away; another (unidentified) Snowy Owl appeared before he had gone more than forty

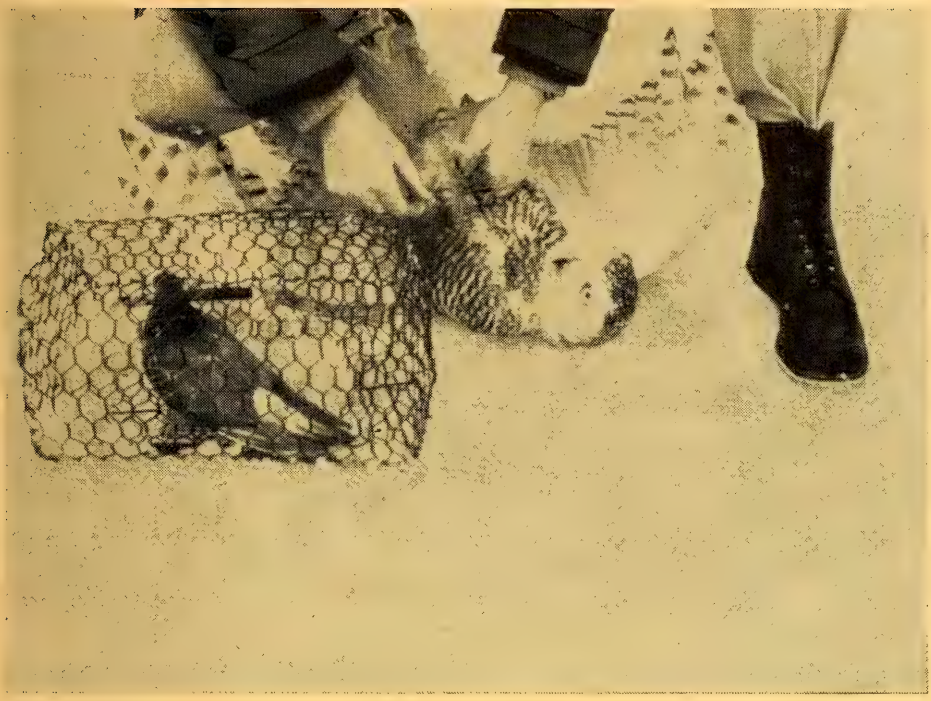

FIGURE 1. Extricating the feet of a large female Snowy Owl from the nylon nooses of a bal-chatri.

yards, and both clashed heavily about fifty feet above the ice. It was almost dark by this time, and neither bird was seen again that day. The second owl seemed to have been the aggressor.

(3) February 11: A trap was set near *Dark Unmarked* just at dusk. She flew to it almost immediately, but shortly afterwards rose quickly to meet another Snowy Owl which approached from the direction of *All Blue's* territory (it was too dark to identify colour markings). About five minutes of aerial gymnastics ensued, during which these two birds clashed again and again in mid-air. One of the owls then returned to the trap.

(4) February 11: At about 9 a.m. *Light Unmarked* and *Orange Right Wing* (both males) were noted sitting on the ice approximately 250 yards apart, but hidden from each other's view by emergent vegetation. As we were watching, a cottontail rabbit, *Sylvilagus floridanus*, suddenly appeared and was seen by *Light Unmarked*, which flew after it. *Orange Right Wing* apparently saw *Light Unmarked* and commenced to chase him for about two minutes. Both owls then settled down in roughly their initial positions. (Unbeknown to us the rabbit had just been released by H. A. Mathiak when we and the owls saw it.)

The response of the marked owls to a captive individual was also tested. On the breeding grounds, Watson (1957) had been unable to evoke any reaction to a flat life-sized model. I employed a live male Snowy Owl, acquired from the Wisconsin Conservation Department. Four of the Horicon owls were confronted with this captive bird, and reacted as follows:

(1) February 11: The captive owl was jessed and set on the ice about 150 yards from *All Blue*, within what I believed was the latter's territory. Our truck had scarcely pulled away before *All Blue* viciously attacked the jessed bird; there was much physical contact involving chiefly the wings and feet. *All Blue* was seemingly oblivious to us during the fight, as we watched from a distance of not more than thirty yards. We terminated the experiment after several minutes because of the beating the captive was taking.

(2) February 20: In mid-afternoon a trap was placed about 200 yards from *Light Unmarked* who was sitting on the ice near some cattails. During the next hour, he moved in several short flights to within five yards of the trap, but would approach no closer. The captive owl was then set out in a wire cage within seventy-five yards of the trap; *Light Unmarked* still did not move. From the beginning, *All Orange*, a large female, had been perched in a tree 0.7 miles distant. Approximately ten minutes after the caged owl was put out, *All Orange* flew directly to it; as *All Orange* approached, *Light Unmarked* flew off. *All Orange* landed near the caged owl, walked around it, and during the next ten minutes struck at the captive bird several times. She then flew over to the trap and was immediately caught.

(3) February 20: In late-afternoon, *Dark Unmarked* made one pass at the caged owl set out near a baited trap. As a result of our numerous unsuccessful attempts to catch this bird, she was becoming very trap-shy, and this may have explained her apparent lack of interest in both the trap and the captive owl.

What was evidently a natural clash between *Green Right Wing* and *All Orange* was mentioned to H. A. Mathiak by a muskrat trapper. This conflict occurred in mid-January.

The approximate areas of five territories, as measured by sight records (Figure 2), were between 0.2 and 1.0 square miles, while their greatest lengths ranged from 1.0 to 1.6 miles (Table 1). *Orange Right Wing* was not included here because he was seen only four times. Territory sizes on the breeding grounds have been variously estimated at about one mile in diameter (Sutton and Parmelee, 1956), and one to four square miles depending on prey abundance (Watson, 1957). Pitelka *et al.* (1955) found nesting pairs spaced one to four miles apart, and Hagen (1960) reported that distances between nests ranged from 0.8 to 2.3 miles, with 1.3 miles being the mean. Thus, as best I can judge at present, the size of winter and breeding territories is comparable.

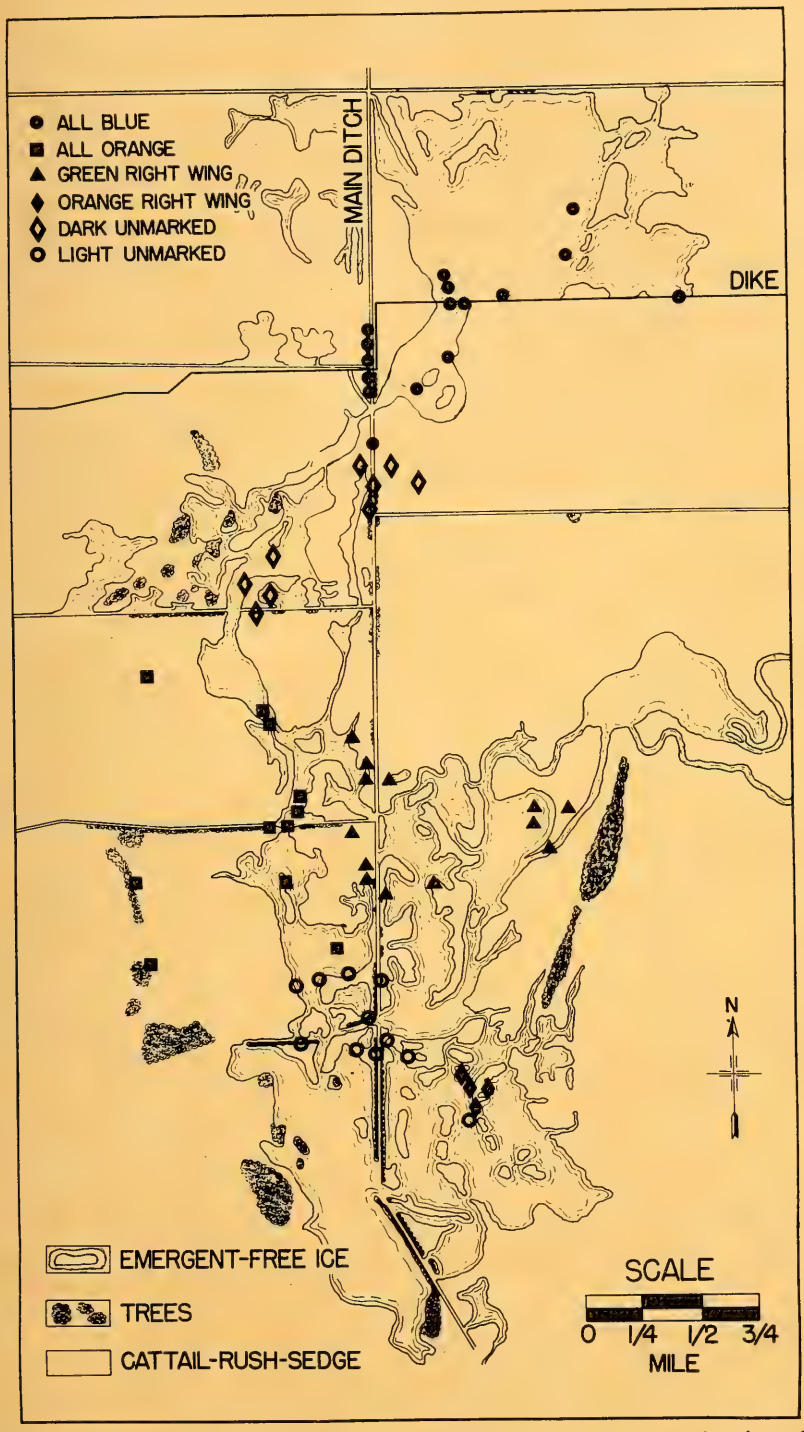

FIGURE 2. A portion of the south end of Horicon Marsh, Wisconsin, showing observed positions of six Snowy Owls during January-February, 1961.

Our knowledge of how and when winter territories are established and later abandoned is still very scanty. The observations of others, as well as my own, suggest that the owls tend often to arrive from the North in groups, and many have been seen together at such times (Stoner, 1943; Gross, 1947). Yet, even during this same period some overt antagonism may be displayed, as Keniston's (1927) remarks attest: "Snowy Owls are interesting to watch on account of their fights over food. . . . They would sit by the hour side by side, and seemed very loving except at meal time. In the evening and at meal-time they uttered a shrill squeal, evidently a fighting-note." According to Oeming (as reported by Gillese, 1960), "[Snowy Owls] arrive from the north in groups, as early as the first week of September. Oddly, they are lethargic and sluggish at first, uninterested in food, spending their days dozing in the late fall sun. They disperse, and then set up their 'territory,' defending it jealously against intruders." On November 26 and December 2, before the freeze-up, two snowy owls were observed together on farmland bordering Horicon Marsh. Plumage differences indicated that they were a male and a female. These birds were frequently within a few yards of one another, and when flushed several times during photographing, they alighted on adjacent fence posts. No antagonism was witnessed during the period of observation.

February 25 was the last day that I saw colour-marked owls at Horicon. My next visit was on March 11, at which time I snowshoed the area shown in Figure 2; there were numerous open leads in the Marsh, and many waterfowl, but no owls could be found. Whether the birds had gone North, or had simply moved to higher ground, I cannot say. The former would appear more probable, since the Marsh was still largely covered with ice and snow, and food was more abundant than ever with the return of the ducks. Keith (1960) quoted H. A. Hochbaum as saying that at Delta, Manitoba, Snowy Owls shifted their roosts during the spring thaw to the vicinity of remnant snow patches. Mitchell's (1947) description of the behaviour of two Snowy Owls suggests that the onset of the reproductive urge may be involved in breaking down winter territories and prompting the return flight north. She stated that after maintaining separate territories all winter, the male and female were found together one evening towards the middle of March. They rose in the air together, engaging in what Mitchell implies may have been courtship "fighting", then flew off northward side by side.

Other Behavioural Traits

While the pattern of territoriality exhibited by Snowy Owls at Horicon Marsh seems clear, I do not wish to intimate that wintering owls behaved only in this manner. In all likelihood, those birds which settled in open farmland did; for instance, one that I caught and marked on the Arlington Prairie, north of Madison, was routinely spotted on the same square-mile area for at least a month. Keith's (1960) observations on the Portage Plains near Delta, Manitoba, implied similar behaviour.

What appeared to be a significant deviation from this pattern was displayed by that portion of the wintering population which frequented many of the larger lakes and lake shores. These birds could be seen on pressure ridges

TABLE 1. — Summary of data on size of Snowy Owl territories at Horicon Marsh, Wisconsin, January–February, 1961

Description and Sex of Owls	Period Owls Under Observation (Days)	Maximum Distance (Miles) Between Observations	Approximate Area (Sq. Mi.) Outlined By Observations
All Orange (female)	57	1.6	1.0
All Blue (female)	50	1.6	0.8
Green Ring Wing (male)	49	1.1	0.5
Light Unmarked (male)	36	1.1	0.3
Dark Unmarked (female)	45	1.0	0.2

during the day, often a mile or more from shore; they probably hunted over adjacent uplands at dawn and dusk. H. C. Mueller (*pers. comm.*) noted such movements on several occasions. This was probably the same type of behaviour reported to me by H. A. Hochbaum (Keith, 1960). The stomach of a male Snowy Owl that was accidentally killed after being trapped on Lake Mendota contained the remains of five mice, which could hardly have been taken on the lake ice.

During the weekly traverses of Horicon Marsh, it was noticed that owls tended suddenly to become conspicuous about an hour before sunset. This trait had earlier been mentioned to me by F. N. Hamerstrom. Their increased conspicuousness at this time was due to the utilization of trees as hunting perches or observation posts. During mid-day, most owls roosted on the ice or upon muskrat houses. The above behavioural pattern was most pronounced on clear sunny days. I spent too little time on the Marsh in the early morning to say for sure that high perches were used then also, but I suspect they were.

The only vocalization that I heard from Snowy Owls was a cry reminiscent of a Red-tailed Hawk, *Buteo jamaicensus;* only higher in pitch and not so loud. One bird that I attempted to trap on a building in Madison made numerous strikes at the trap without getting caught, and on landing nearby uttered a shrill "kreee" over and over again.

Rough-legged Hawks, *Buteo lagopus,* were very common at Horicon during the winter of 1960-61, and frequently attacked Snowy Owls. The hawk was the aggressor in all conflicts witnessed by me. Such attacks were neither persistent nor intensive like those reported on the breeding grounds (Sutton and Parmelee, 1956), amounting usually to no more than one or two dives at a perched owl. Both species, of course, tend to invade southern regions in large numbers during the same winters (Speirs, 1939).

Reference is often made to the shyness of Snowy Owls and the difficulty with which they are generally approached (outside the nesting season), both in the North and during their southern invasions. My own experience tends mainly to support this contention, thus the behaviour of the owl previously referred to as *All Blue* may be of interest. This individual's chief perches were situated along the Main Ditch (Figure 2) near a favourite ice-fishing area in the Federal Refuge. Within a week after fishing began, *All Blue* seemed completely conditioned to the presence of human beings. She would sit for hours not more than thirty to forty feet above the fishermen. On one occasion

three of us were looking for pellets beneath a tree that she was perched in. After watching us intently for several minutes, she flew to another tree about one hundred yards away, but shortly thereafter returned and perched only twenty feet above us.

SUMMARY

1. Territorial behaviour of Snowy Owls at Horicon Marsh, Wisconsin, during the winter of 1960-61 is described.
2. Territories were defended against other snowy owls wintering in the area, and a captive owl that was placed within three different territories was attacked.
3. The observed size of five territories ranged from 0.2 to 1.0 square miles; their maximum lengths were 1.0 to 1.6 miles.
4. Other aspects of behaviour displayed by wintering Snowy Owls are discussed.

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SPRING AND SUMMER PHENOLOGY AT BAKER LAKE, KEEWATIN, N.W.T., DURING 1959-62

CHARLES J. KREBS
Department of Zoology, University of British Columbia, Vancouver.*

THERE ARE VERY FEW phenological records for the Canadian arctic taken at the same place over a series of years. The following observations were made at Baker Lake (64° 19′ N, 96° 02′ W) in central Keewatin during a four-year study of lemming populations sponsored by the Arctic Institute of North America.

WEATHER

Table 1 summarizes the temperature and rainfall data for 1959-62 as gathered by the Baker Lake Meteorological Station. There was considerable variation between these four summers. In temperature they ranked: 1960 (warmest) > 1961 > 1962 > 1959 (coldest), and in rainfall 1959 (wettest) > 1962 > 1960 = 1961 (driest).

TABLE 1. — Temperature and rainfall data during the summers of 1959-62 at Baker Lake, and the mean values for 1950-60.

	June	July	August
Mean Monthly Temperature (°F)			
1959	35	50	46
1960	46	54	52
1961	41	53	46
1962	36	52	50
Mean 1950-60	39	52	50
Total Rainfall (in.)			
1959	0.89	1.78	2.71
1960	0.14	1.28	1.11
1961	0.37	0.24	1.98
1962	1.24	1.49	1.73
Mean 1950-60	0.73	1.55	1.72

PHENOLOGY

Figure 1 presents data on eleven physical and biological events of the spring and summer phenology in the Baker Lake area. Most of these events are self explanatory. *Pedicularis lanata* is usually the first flower of the season and *Epilobium latifolium* is usually the last plant to bloom (excluding grasses, sedges and willows). Plants in unusual situations were disregarded in determining the dates when blooming began.

*Present address: Museum of Vertebrate Zoology, University of California, Berkeley.

COMPARISON OF GROWING SEASONS

Information on the amount of standing forage in sedge marsh habitats at the end of each summer's growing season was gathered on paired enclosed and open quadrats in order to measure the effect of lemmings on their forage. These data, reported in detail elsewhere (Krebs, 1963), show a steady increase in forage produced from 1959 to 1962 in both the open and enclosed quadrats:

	1959	*1960*	*1961*	*1962*
Enclosed	100%	139%	168%	175%
Open	100%	124%	150%	192%

The reasons for this steady increase in production remain unknown. The yields are poorly correlated with temperature and rainfall, cannot be attributed to the grazing effects of lemmings (which peaked in 1960), and are not due to changes in techniques.

DISCUSSION

Bruggemann and Calder (1953) have pointed out that spring phenology appears to be later as one moves north to about Baker Lake and Chesterfield Inlet, but in the high arctic above this latitude spring comes slightly earlier. Savile (1959) has supported this observation, and the data presented here also seem to fall into this pattern.

Table 2 summarizes the reported dates of first flowering for two species which occur at many of the localities studied, and shows that the high arctic stations have as early or earlier springs as Baker Lake.

There is some difficulty in comparing dates of first flowering for all these different areas because it is not always clear whether this refers to the earliest date the species was found in flower in the most favorable situations (e.g. on the south side of a large rock in dark soil) or the earliest date the species was found in flower in a normal, open tundra situation. I have used the latter meaning. For the species from Baker Lake discussed here these two dates would differ only slightly; in other situations these dates could differ by as much as two weeks.

TABLE 2. — Phenological comparison of eastern arctic stations.

	Date of first flowering	
	Saxifraga oppositifolia	*Dryas integrifolia*
Alert[1], 1951	8 June	1 July
Isachsen[2], 1954	20 June	—
1960	18 June	—
Chesterfield Inlet[1], 1950	22 June	6 July
Frobisher Bav[1], 1948	—	22 June
Baker Lake, 1959	6 July	10 July
1960	14 June	16 June
1961	24 June	27 June
1962	30 June	4 July

[1]Bruggemann and Calder, 1953.
[2]Savile, 1961.

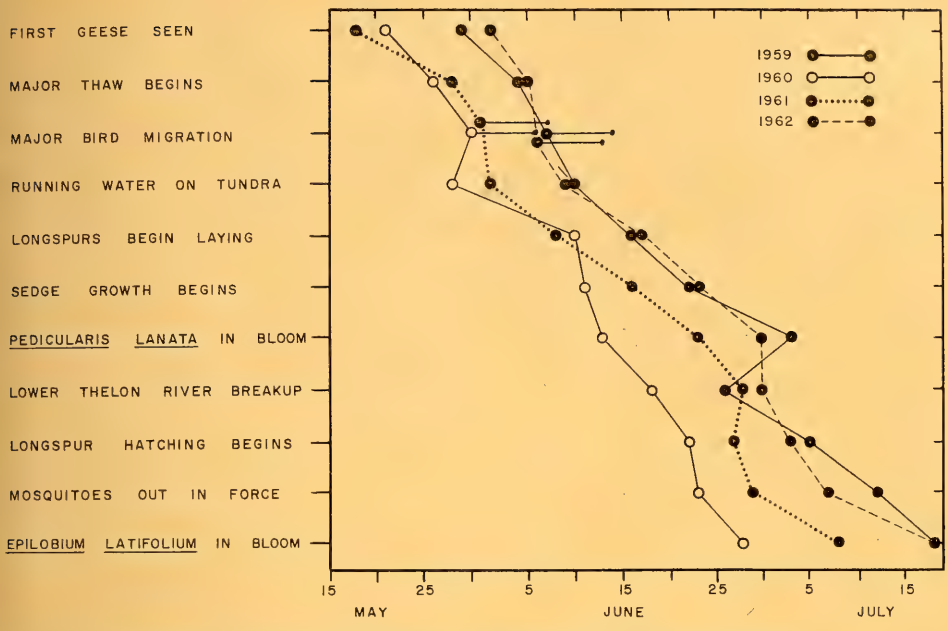

FIGURE 1. Spring and summer phenology at Baker Lake, Keewatin, 1959-62.

SUMMARY

1. Four years' data on eleven physical and biological events of the spring and summer phenology at Baker Lake, N.W.T., show wide variation between years.

2. There is also great variation in the amount of standing forage produced in wet habitats, and this does not seem to correlate well with temperature, rainfall, or with the season's phenology.

3. The evidence presented seems to support the observation of Bruggemann and Calder (1953) that high arctic stations have earlier springs than do low arctic stations like Baker Lake.

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A DISTRIBUTIONAL SUMMARY AND SOME BEHAVIORAL NOTES FOR SMITH'S LONGSPUR, *Calcarius pictus.*

Emerson Kemsies and Worth Randle
University of Cincinnati, Cincinnati, Ohio

Since publication of the Fifth Edition of the *A.O.U. Checklist of North American Birds* the winter distribution of Smith's Longspur has been more accurately defined by an increase in published observations. These observations have appeared in such journals as the *Auk*, *Wilson's Bulletin*, the *Migrant* (Tennessee), the *Texas Ornithological Society Newsletter*, and *Mid-South Bird Notes*. Other records, the authors have garnered from direct correspondence with such well-known ornithologists as Ben Coffey in Tennessee and Tom Imhof in Alabama. A brief summary of records, other than for Ohio which is summarized separately, will indicate the present distributional status. Beginning in 1951, Smith's Longspurs began to turn up at Lonoke, Arkansas, where fifteen were identified on December 24. Since that time Ben Coffey, *et al*, working nine airports and a few pastures, have compiled a number of records ranging from the latter part of November to early March. As many as 155 were seen at Ft. Smith Airport on November 26, 1955, and 110 the next day at Hot Springs Airport, but totals dropped considerably thereafter until March 11. He has recorded varying numbers up to 1960. Coffey and his colleagues working in nearby Mississippi, located eleven Smith's Longspurs at Sanders Field on November 29, 1953, the first record for the state. Subsequently, and up to 1960, this species was discovered at four other airports throughout the entire winter; they were in small flocks of not more than fifteen birds. In Tennessee on November 22, 1953, Ben Coffey found the first state record for the species at the Memphis Penal Farm; on November 28 he counted a flock of twenty-seven Smith's. In two other places in Tennessee Coffey reported this Longspur in small numbers intermittently through 1959, extending from the latter part of November through mid-March. Meanwhile, Horace H. Jeeter, working in Louisiana, discovered the first state record of this longspur on an airport north of Shreveport, on December 13, 1952. On January 25, following, Jeeter counted 46 individuals in the same place. He noticed that these birds always occurred in the same patch of a characteristic grass which was later identified as of the genus *Aristida*. (In two birds collected by Coffey, one in Tennessee and one in Mississippi, seeds of this same grass were found.) As in the other Southern States, Jeter's records show a numerical decline during February; while 100 were still present on March 1, none were found on March 8. In Alabama, Tom Imhof found the first Smith's Longspur for that state on an abandoned Birmingham airport on December 5, 1955. One was still there on January 17. Another was found on pastureland near Marion in December of 1957 and two more near Montgomery feeding on waste grains of wheat in December of 1958.

Although Ridgway (1901) lists northwestern Indiana and Illinois in his distributional summary for *pictus* at the turn of the century and the authors have made several recent observations and collected two specimens from Jasper County, Indiana, in April of 1955, the first conclusive record of Smith's Longspur for Ohio was not established until April 18, 1949, at the Miama University Airport, near Oxford in Butler County, when four specimens were collected, all males in advanced molt (Kemsies, 1950). Since that date, the species has been found there regularly each spring and once in the fall. There is an old record of two specimens of *C. pictus* reportedly taken by Clark P. Streator at Ravenna in northeastern Ohio on January 29, 1888 (Jones, 1904). In the original note, no mention was made of the disposition of the specimens. Extensive search by Kemsies has failed to locate them. Streator's date of late January is amazing in light of Ohio observations in the past twelve years, inasmuch as this species has not been seen at Oxford before March 15 in spring and only once in fall, on November 15. These birds have usually appeared during the last week of March and have departed by late April. At least one specimen has been taken during each of the first ten years of observation; these are in the University of Cincinnati Collection.

Elsewhere in Ohio, records may be summarized quickly: Arthur B. Williams (1950) lists two possible sight records for May 8 and 24, 1924; Irving Kassoy and Donald Smith found an estimated flock of 250 in Walnut Township on April 15, 1956 (Pickaway County); Milton B. Trautman saw three on April 16 in the same general area, 150 on April 19, fifty on April 22, thirty on April 23 (he collected one on this date), and two on May 1 (in the company of Edward S. Thomas of the OSU Museum). On April 3, 1954, Trautman and Kemsies collected one in Auglaize County at the State Fish Hatchery. From April 15 to 29, 1956, Neil Henderson recorded a flock of about twenty-five Smith's Longspurs at the Cuyahoga County Airport; he saw one or two here in March and April of 1957 and April of 1959, also.

The regular occurrence of this species at Oxford Ohio Airport every year in rather large numbers poses many interesting questions concerning its distribution and migration. Although as many as 250 individuals have been noted at one time at the airfield, it is not known how many birds pass through the area nor the length of time individuals remain. A summary of banding records emphasizes a general paucity of information concerning this species. Previous to 1958 only five Smith's Longspurs had been banded – all juvenals at Churchill, Manitoba. A. V. Harper banded three on July 15, 1933, and G. B. Happ banded two on July 17, 1941. After several unsuccessful attempts due to strong seasonal winds, Ronald Austing and Edward Johnstone trapped and banded the first adults, two males and a female at the Oxford Airport on April 14, 1958. Using mist nets set at places preferred by the longspurs, the three birds were "herded" with considerable difficulty to within twenty feet of the nets and then quickly flushed into them. The following year, 200 pounds of cracked corn were used as bait, and the birds were quick to find it. From March 28 to April 23, thirty-nine Smith's Longspurs were caught and banded. Five were retraps – two of the birds banded on April 4 were retaken on April 10, six days later; another banded on April 4 was retaken on April 23, nineteen days

later; one banded on April 10 was recaptured on April 18, eight days later; and another banded on April 10 was retaken on April 23, thirteen days later. In 1960, cracked corn was tried again, but the birds showed no interest in it. Additional bait — seeds of clover, orchard grass, and lespedeza — was tried without success. Six birds were eventually banded at a nearby puddle of water where seventy to eighty came regularly just before noon to drink and bathe. Again unfavorable winds prevented the capture of more longspurs. Thus, a total of forty-eight were banded during the three-year effort.

On November 15, 1958, Jay M. Sheppard (1959) collected two Smith's Longspurs from a flock of thirteen birds seen at the Oxford Airport. These specimens are in the University of Cincinnatti Collection and mark the only fall date for Ohio. Professor W. D. Klimstra of Southern Illinois University examined the crops of both specimens. He writes, "We have examined the crops of the two Smith's Longspurs. In the case of both there were two species of plants represented: *Sporobolus vaginiflorus* and *Digitaria ischaemum.* In both cases *Sporobolus* represents over ninty-nine per cent of the seeds. I would not stake my life on the species identification; however, I am reasonably sure that it is correct." It is interesting to note that no seeds of the genus *Aristida* were discovered in the crops of these two birds although *Aristida* grass occurred in the field where they were collected.

Detailed information about this species' general habits and behavior is meager. Birds at the airport are often very unwary and may be approached to within fifteen or twenty feet. When first flushed they are likely to fly close to the ground for a distance of only twenty or thirty yards. Repeated flushing usually results in the birds spiraling high, occasionally out of sight, and remaining aloft for several minutes. The rattling call notes are commonly given as the birds take wing, but are also heard on the ground. These notes are similar to those of the Lapland Longspur, but some observers believe that they can detect a difference in quality between the two species. A group of birds calling overhead may induce others on the ground to join them in flight, or vice versa.

In August, 1958, Kemsies had the opportunity to visit Churchill, Manitoba, to see the species on its breeding ground. Through the kindness of Mrs. H. L. Smith, he was able to visit four areas where the Smith's Longspur occurs. At one location a male flew up from the tundra and perched in a black spruce, about eight feet from the ground, giving the alarm rattle steadily. A few minutes later two nearly full grown young and a female flew up from the ground near the base of the spruce. The elevated perch of the male astonished Kemsies, who had previously seen the species only on the ground.

According to our observations at the airport and in northwestern Indiana fields, Smith's Longspurs do not associate with the Laplands, *Calcarius lapponicus,* unless they are forced into close proximity by such circumstances as a general disturbance of migratory concentration or by crowding during the peak of the massive migration of *lapponicus.* Mrs. Smith mentioned that she has recorded *lapponicus* at her feeding station in spring, when both *lapponicus* and *pictus* are present in the area, but that she has never seen *pictus* anywhere in town. She also indicated that, usually, most of the Smith's departed before the

end of August. In the spring, both birds are found around Churchill for a short period, but they apparently never associate.

In 1959 and 1960, Kemsies undertook a taxonomic study of the species to determine whether there might be subspeciation as with *lapponicus*. From an examination of 240 specimens, the species *pictus* was subdivided into three races —an Ontario race breeding along the Hudson Bay coast, a Churchill race breeding north and west from that place, and a Central Alaskan race (Kemsies, 1961). So far it would appear that birds migrating as far east as Ohio come from both Alaska and Churchill. There is only one migratory record of the Ontario race and this is from Kansas.

The authors hope that with increasing observation of the Smith's Longspur more data may be compiled to present a more detailed map of the distribution of the species and its races and to gain further knowledge of its behavior.

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FLOWER VARIATION OF *Epilobium angustifolium* L. GROWING OVER URANIUM DEPOSITS*

HANSFORD T. SHACKLETTE
United States Geological Survey, Denver, Colorado

FLOWER COLOR VARIATION in fireweed, *Epilobium angustifolium* L., is known throughout the wide range of this common species. In its North American range Anderson (1959, p. 350) describes the color as "petals . . . rose-purple or occasionally white or pink." Fernald (1950, p. 1058) states, "petals magenta or pink (rarely white)," and lists two color forms as being "occasional" and "local." Hultén (1947, p. 1146) says, "The whiteflowered type with white sepals, f. *albiflorum* (Dum.) Hausskn. is not rare, nor is f. *spectabile* (Simmons) Fern. with white flowers and red sepals. Specimens with more or less striate or darkveined petals also occur." These forms mentioned by Hultén were discussed in more detail by Fernald (1918, p. 4). Gleason (1952, p. 586) gives the flower color as "petals purple, varying to white" and adds, "Numerous varieties and forms have been described, but the variants within our range seem to be environmental rather than genetic."

The experience of the writer has been that the species, from a numerical standpoint, shows a remarkable uniformity of color throughout a great variety of habitats. The plant is so common in the north temperate to arctic regions that it often forms a blanket of color over vast areas, particularly on disturbed sites where logging, road building, or fires have produced an ecological disturbance. Yet in all this abundance of flowering specimens, variations in color from the usual magenta were seldom found. Certain ecological forms may have somewhat more intense color in an adverse environment, such as in overdrained, poor soil or at their altitudinal limit. Reduced sunlight tends to inhibit color development, thus paler forms are often found on shaded sites.

In Alaska this plant often assumes "aspect dominance" along the highways during its flowering season, frequently growing on the road shoulders through areas where it is unable to grow elsewhere. It is classified as a nitrophilous species by Braun-Blanquet (1932, p. 239), its occurrence on disturbed soil apparently being related to the more rapid nitrification in such soil. Analysis of this plant as found growing under natural conditions in Alaska reported by Sweetman and Bundage (1960, p. 4) show it to have an unusually high protein content (average 19.4 percent of dry weight), which indicates that it most probably has a high nitrogen requirement for optimum development. If the hypothesis of Sutcliffe (1962) is correct, viz., that the protein molecule is the principal "carrier" of ions from the soil solution across the cytoplasmic membrane and into the cytoplasm and central vacuole, plants with a high rate of protein synthesis should be especially active in absorption of salts from the substrate. Sutcliffe says (1962, p. 163), "Salts diffuse across the cellulose cell wall . . . to the surface of the cytoplasm where

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they become attached to protein molecules located in the surface membrane . . . . As a result of protein synthesis, new sites are created to which salts may be bound, and uptake from the medium continues as long as newly synthesized protein is being exposed at the external surface." From this it appears that plants having a high rate of protein synthesis and the accompanying increase in salt absorption may be more affected by unusual substrate chemical composition than are those having a low rate.

The writer, in driving over the highways of Alaska, British Columbia, and Yukon Territory, has scanned the roadsides for the occurrence of abnormally colored flowers of this species. On the Haines Highway near Dezadeash Lake, British Columbia a variant was found which was easily seen from a considerable distance. Closer examination showed the variation to be limited to a large, many-stemmed clone, in which the sepals and petals were almost pure white with only a touch of pale pink near their bases. In the summer of 1960 six clones of light pink variants were observed, all in the vicinity of Circle Hot Springs, interior Alaska. No other color variants were seen during three summers of field work in many areas of Alaska having extremely diverse habitats.

Field studies of this species were made by the writer in 1948 while he was a member of the Port Radium Expedition of the Botanical Gardens, University of Michigan, for the Detection of Hereditary Mutations in Plants, an expedition supported by the Office of Naval Research, U.S. Navy. The principal areas of study were in the vicinity of Port Radium, at Sawmill Bay, and at Dease Arm, all on Great Bear Lake, Northwest Territories, Canada, although observations were also made at Coppermine on Coronation Gulf, and at Great Slave Lake. Fireweed was found in profusion in all these areas and was one of the plants under close observation for variation in color or other characteristics. No variation was seen until a study was made of this species growing in the vicinity of uranium ore at Port Radium. Here immediately adjacent to the "glory hole" (the site of the original uranium ore discovery and from which ore had been removed by surface mining) and in the small drain leading therefrom to the bay was a colony of fireweed having great variation in color. The variants occurred as individual clones, each having uniformity of color within the clone. Eight of these were selected for study, and descriptions of flower color were made before the specimens were dried in the plant press. A comparison of these clones is given in Tablue 1. It should be noted at this point that quite near the site of these *Epilobium* variants were found the clones of *Vaccinium uliginosum* L. which exhibited a remarkable diversity in fruit shapes (Shacklette, 1962).

In regard to the six clones of fireweed having pale pink petals mentioned earlier, it is noteworthy that in this part of Alaska there is greater-than-average ground radiation associated with the localized intrusive granitic rocks. In discussing radioactive deposits in the Circle Hot Springs area Nelson, West, and Matzko (1952, p. 15) conclude that there is little hope of discovering commercial concentrations of uranium in this area by the use of portable survey meters because of the widespread cover of vegetation, soil, and disintegrated bedrock; but they add "On the other hand, this area, particularly the watershed of Portage Creek, cannot be ruled as unfavorable for the occurrence of uranium in

lode deposits, because of the relatively high uranium content of water and the presence of uranothoriate in concentrates from Portage Creek. Prospectors . . . . will probably find that geochemical methods of prospecting, such as water, soil, and vegetation sampling, would be the best techniques to use in the search for uraniferous lodes in the area." A description of the color variant found here (clone No. 9), as well as of a "typical" plant of this species from this region (clone No. 10) is given in Table 1, and the two forms and their pollen are illustrated in Figure 1, A, B, D, and E.

Mr. Robert M. Chapman, Geologist, U.S. Geological Survey, reports in correspondence (College, Alaska, February 21, 1963) the occurrence of a single group of white-flowered fireweed near the Richardson Highway in the vicinity of Paxon, Alaska. He writes that although no anomalous areas of radiation are known to occur near here, "There is some mineralization of gold, copper, and some other metals, and the possibility that this particular fireweed might have been subjected to more than normal radiation cannot be entirely ruled out."

A specimen of white fireweed has been kindly sent the writer by Mrs. Florence R. Weber, Geologist, U.S. Geological Survey, College, Alaska, who collected it "east of Fairbanks International Airport, elevation 435 ft., side of small road, open woods, on silty soil of the Tanana River floodplain, June 20, 1959." She states in correspondence that it "was the only white one amidst a group of normal colored plants . . . it is the only white fireweed I have ever seen." The dried herbarium specimen (Figure 1, C), which is in full flower, shows no trace of anthocyanin in any of its parts, the leaves are much narrower and shorter (maximum, 4.7 cm long, 6 mm wide) than usual for the species, and the entire plant has a slender aspect. The flower parts are smaller than those of typical plants. The locality and substrate from which this specimen came do not suggest any unusual environmental conditions.

While examining the field notebooks (lent me by Dr. Howard A. Crum, National Museum of Canada) written by the late Dr. Louis H. Jordal during his botanical explorations on the south side of the Brooks Range, Alaska, the following entry was found: "Wiseman, Alaska, June 21, 1949 . . . The people have been commenting on a peculiar *Epilobium angustifolium* which is said to have arisen on some heaps of mine diggings at Nolan. It is reported to have greenish flowers, not to spread, and never set seed. The kids brought over a couple of clumps of these to my cabin, where I dug them in along the north wall. Maybe they'll revive." A later entry (Wiseman, July 18, 1949) is as follows: "2328, *Epilobium angustifolium* f. *albiflorum* (Dum.) Hausskn. Albino. Only local stand, around old cabin whereto once brought from dump of mine tailings at Nolan where this variant is said to have occurred spontaneously only once. Does not spread, and perhaps not produce viable seeds. Flowers pure white." This specimen (No. 2328) presumably is from the clumps transplanted to his cabin as mentioned in his first entry, and is preserved in the Herbarium, University of Michigan. In addition to this specimen there is another variant of this species, referrable to *E. angustifolium* f. *spectabile* (Simmons) Fern., in this same herbarium, and which is recorded in his field notebook (Wiseman, July 18, 1949) as follows: "2326. *Epilobium angustifolium* L. In

TABLE 1. — Comparison of flower variation in *Epilobium angustifolium* clones growing at Port Radium, Great Bear Lake, N.W.T., Canada, and Circle Hot Springs, Alaska.

Clone No.	Petals	Sepals	Filament	Anther	Pollen	Style	Capsule	Leaves
1. (Specimen No. 3130)	pale rose pink	cerise	pure white throughout	dusky pink	pale blue	white throughout	erect; red above, paler beneath	yellowish-green
2. (Specimen No. 3131)	magenta, paler than typical	reddish-purple	pure white throughout	yellow	very pale blue, almost white	white throughout	erect; paler than usual	normal color
3. (Specimen No. 3132)	very pale rose pink; undulate, appearing fringed	clear rose red in sun, otherwise greenish	white, pink at base	purplish	greenish-blue	white throughout	erect; dusky pink	normal color
4. (Specimen No. 3133)	very pale pink, appearing almost white; pure white in anthesis	pale to clear rose pink	white, rose at base	purplish	bluish-green	white throughout	spreading; shorter than normal	more glaucous than normal
5. (Specimen No. 3134)	intense magenta; wilted petals deep fuchsia	darker than petals, purplish	pure white throughout	purple	very pale, slightly bluish	white; stigmas purplish	erect; pale pink	normal color
6. (Specimen No. 3135)	most intense magenta of entire population; wilted petals deep fuchsia	very slightly darker than petals	pure white throughout	reddish	pale blue	white; lobes red on recurved side	erect; medium length	normal color
7. (Specimen No. 3147)	pale magenta; number varying from 3 to 7	rosy-purple	pure white throughout	yellow	blue	white throughout	erect	normal color
8. (Specimen No. 3148)	– do –	– do –	– do –	– do –	– do –	– do – multiple stigmatic branches	– do –	– do –
9. (Specimen No. 6405. Alaskan)	uniform light pink	clear red	white, to pale pink at base	pale pink with maroon sutures	yellowish-green	white throughout	ascending; red above, pale green beneath	normal color
10. (Specimen No. 6406. Alaskan) Typical for the species.	magenta	dark magenta	very pale pink, turning white	greenish	light blue-green	white throughout	erect; reddish above, greenish beneath	medium green; not yellowish or glaucous

more or less dense stands, in drained open situations. Petals pale, sepals deep purple. Wiseman."

From the evidence presented above it appears that the color variants of fireweed, although generally rare, are frequently (but not invariably) associated with the occurrence of substrates having unusual properties. This observation prompts a closer examination of the nature of this variation, with a search for causal relationships. First, a genetic evaluation of this plant will be suggested, although Michaelis (1954, p. 294) says, "A complete genetic analysis in *Epilobium* is not yet possible . . ." Most research on inheritance in this genus has been done with species other than *E. angustifolium*. Schwemmle (1924) states that all *Epilobium* species have the same number of chromosomes, that is, n = 18. However, abnormalities in the genome complement of pollen are known, resulting in hypohaploid and hyperhaploid conditions. Michaelis (1954, p. 293) writes that the normal haploid pollen grain in the Onagraceae family has three large germ pores, the hypohaploid pollen has only one or two germ pores, and the hyperhaploid pollen has more than three germ pores. Mr. John R. Keith, Department of Botany, University of Michigan has kindly examined pollen of my specimens No. 6405 (f. *spectabile*) and No. 6406 (f. "*typicum*"), both from Alaska, and the Alaskan specimen (f. *albiflorum*) of Mrs. Weber (Figure 1). He reports (in correspondence): "Basically, all three forma have the same type of pollen, as described in your Michaelis reference; that is, the pollen is essentially all haploid. The occurrence of the diploid grains in 'typicum' indicates no unusual irregularity, from the standpoint of percentage of normal grains. For a more statistically valid account I made observations of 387 grains of your '*typicum*' sample, of which only 2 were diploid. To obtain a correlation for this figure, I counted 243 grains from a slide of *E. angustifolium* from Isle Royal, Michigan, in the University of Michigan reference collection, and obtained 43 diploid grains. I do not know why this reference specimen should have a much higher percentage of diploid forms than your '*typicum*'—perhaps it is actually some sort of variant . . . Measurements of these grains give the following sizes (across body only, pores not included): *albiflorum*, 62 microns; *spectabile*, 60 microns; '*typicum*' haploid, 59 microns; '*typicum*' diploid, 61 microns."

From these studies it appears that color differences in these forms are not related to different conditions of ploidy in the male gametophyte. It should be added that dwarfing or heterosis, which are often associated with abnormal ploidy, were not found by field observations at Great Bear Lake to distinguish the color variants from the normal plants, although Mrs. Weber's pure white form from Alsaka (Figure 1, C) was somewhat reduced in size of its parts. This suggested genome stability may favor an increased rate of radiation mutations, as concluded by Nilan (1956, p. 156) who reports, "Thus . . . it has been generally accepted that polyploidy influences [reduces] the apparent frequency of all mutations in a similar vein. Furthermore, it has been held that reduplication of genes confers a buffering ability which enables the polyploid to tolerate greater X-ray damage and to exhibit fewer mutations than the diploid."

Michaelis (1954) presents abundant evidence of cytoplasmic inheritance by means of postulated "plasmons" in *Epilobium* which act in concert with, or

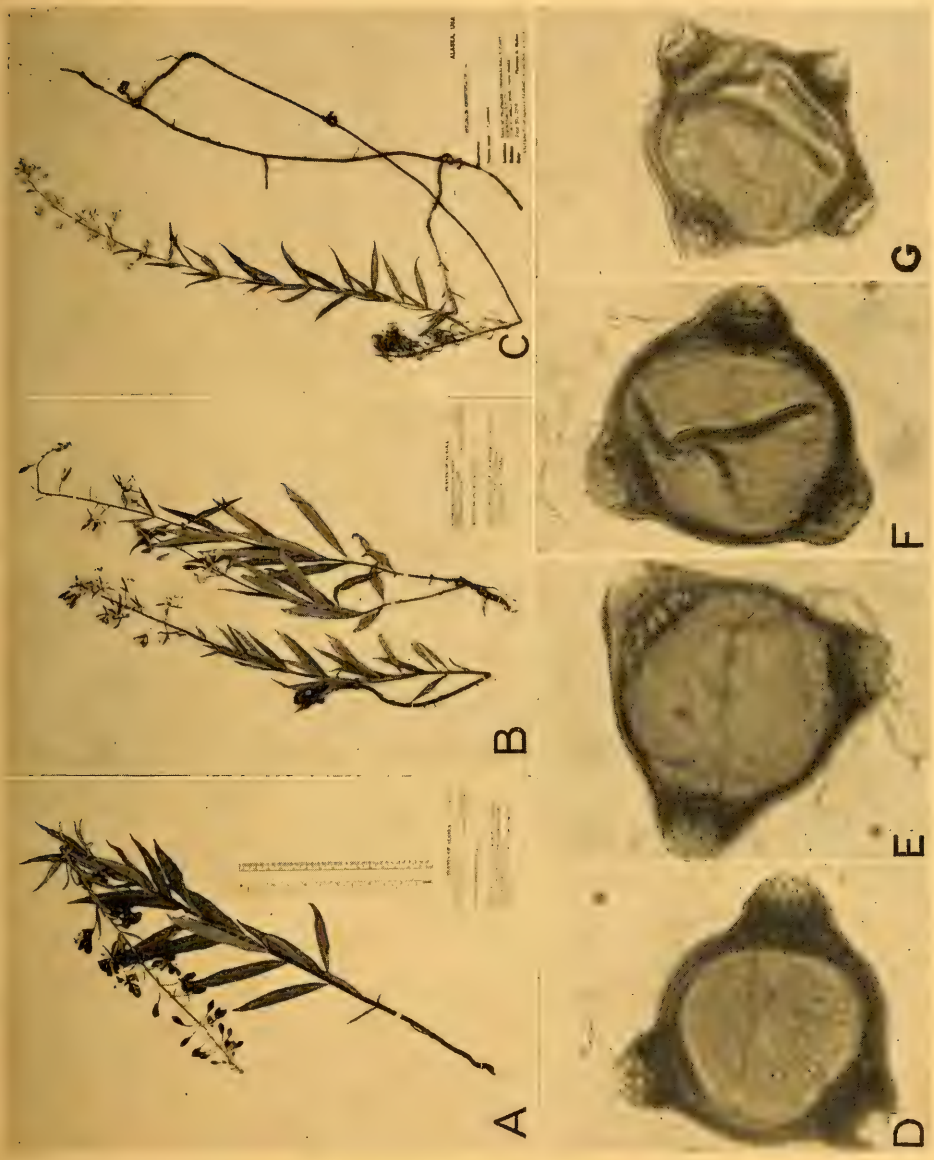

FIGURE 1. Plants and pollen, *Epilobium angustifolium* forms. A, plant and D, haploid pollen of f. "*typicum*". B, plant and E, haploid pollen of f. *spectabile*. C, plant and F, haploid pollen of f. *albiflorum*. G, diploid pollen of f. "*typicum*".

antagonistic to, certain genes in producing phenotypic expression of characteristics. He says, in speaking of the plasmon of *E. hirsutum* Strain Jena (1954, p. 307) that a large number of F_1 crosses and backcrosses show that the cytoplasms are not all alike, and that their differences can be transmitted over an indefinite number of generations. These cytoplasmic differences, however, cannot be associated with certain phenotypes. The observed phenotypes, expressed as distorted leaves, stunted or heterotic growth forms, abnormal occurrence of, or lack of, anthocyanin, and so forth are believed by Michaelis to be due to disturbances of the gene-cytoplasm relations. He further holds that these cytoplasmic factors (plasmons) can change in a manner at least analogous to mutations, which he prefers to call "alterations." They are reported (1954, p. 298) to "maintain their reaction norm even while subject to the influence of a foreign nucleus for as long as 24 generations." Exposures of the plants to radiation (1000r to a sublethal dose) and fertilizing the plants with radioactive phosphorus and sulfur produced no unquestioned cytoplasmic alterations. However, among the phenotypic effects produced were growth stimulation at low doses, fine spotting of leaves, anthocyanin formation in the vegetative zone but not in the inflorescence, and transformation of flower buds to vegetative buds (1954, p. 351-352).

An explanation of this cytoplasmic-nuclear interaction is offered by the hypothesis of Ross (1948) that disharmonious interaction between gene and cytoplasm may disturb the enzyme balance in varying degrees, and may be expressed, for example, by inactivation of oxidative enzymes thus making the anthocyanins disappear. Treatment with heteroauxin, reduction of respiration by low temperatures, cultivation under short-day conditions, and excess carbohydrate accumulation diminish these disturbances, whereas high temperatures or long-day conditions tend to increase them (Michaelis, 1954, p. 307-308). These reported differences in response may offer a partial explanation of the changes in *E. angustifolium* discussed in this paper, for the observed variations were all in an environmental of long-day growing season, and at least in some habitats occasional high temperatures during this season in the individual microhabitats. Michaelis (1954, p. 309) states, ". . . [cytoplasmic] differences were found even among strains that lived distances of only 0.5 to 3 km. apart. The cytoplasm of strains that lived in the same geographical area, but in different ecological niches—for example, in dry ground or moist ground, turned out to be different."

A rather special type of "inheritance" in this genus, the transmission of plastids through the pollen tube and their incorporation into the new zygote, is reported by Michaelis (1954, p. 295) to result in paralbomaculate plants. In his experimental plants it occurred only rarely, and could not be produced by X-ray radiation (2000r to 9000r). However, this phenomenon may be the explanation of the "more or less striate" petals mentioned by Hultén (1947).

Whether the variations reported in this paper are produced by cytoplasmic or nuclear alterations, the variants described in Table 1 can be discussed in traditional heredity terms. From this table it is apparent that the color of the various flower parts is inherited separately (not linked). For example, the clone (No. 4) with the palest petals has the reddest filament bases, whereas the

clone (No. 6) having the most intense magenta flowers had filaments that were white throughout. The range of colors through the anthocyanin series seems to indicate a cumulative color effect; in the absence of breeding experiments, it is suggested that this range may be due to multiple genes existing as three or more pairs of alleles. The color series shown by the anthers, i.e., both anthocyanin and xanthophyll, may indicate that this inheritance is determined by multiple alleles, with either the gene for anthocyanin or the gene for xanthophyll production occurring in an individual clone. There could also exist at the same time the condition of multiple genes, which would explain the anthocyanin range of variation; variation in xanthophyll, however, was not observed.

These postulated multiple allelic mutations are of a type that can be caused by ionizing radiation mutagens (in the Port Radium location, alpha, beta, and gamma radiations from the uranium ore). The low level of radiation provided these plants in this natural habitat during the long period when plant occupancy of this site was possible is believed to be sufficient to have caused the variations that occurred. In this matter Sparrow and Pond (1956, p. 135-136) state that exposure of flowering plants to low levels of chronic gamma radiation did result in an increase in the number of somatic mutations, and conclude, " . . . mutations are produced to a significant degree with low dose rates, a nonlinear relationship has frequently been found to exist between the number of induced mutations and the dose rate, and seasonal and biological variations affect the degree and nature of the radiation effect."

Nilan (1956, p. 158), in discussing the effects of temperature on plant radiosensitivity, says, "Less extreme temperatures have also been effective in altering the radio-sensitivity of plant tissues. Generally speaking, tissues irradiated in temperatures ranging from 0°C. to 20°C. are more sensitive than when the radiation is conducted at temperatures slightly above or below this level." It should be noted that in the regions considered in this paper a fair estimate of ambient temperature range during the growing season is just that mentioned by Nilan above.

Mutations of a single gene are expected to produce changes in one factor in differing degrees, or less commonly, to affect different characters (Snyder and David, 1957, p. 352). These authors (1957, p. 353) further point out, "Two identical genes at corresponding loci mutate independently, just as different genes do." The resulting heterozygosity in respect to these alleles normally would segregate and recombine in succeeding generations, thus producing genotypic variants which could reproduce indefinitely by vegetative means, and which would result in clones of specific and uniform phenotype.

The variation of the flower parts considered together demonstrates the fact that the cause of mutations, whatever it may be, is not a gross environmental cause affecting all genes alike. It is suggested that here the long exposure of this genetic stock of fireweeds to a radioactive substrate has provided sufficient time for many such mutations to have occurred, and that these mutations have been preserved in the offspring to be phenotypically expressed according to the well-known principles of heredity.

From these observations it is apparent that the comment of Gleason (1952) --that in the range of his study the variations are environmental, not genetic—

does not agree with the conclusions regarding variants in the area of this study. Throughout this area examples of variation were rare, even in very diverse habitats. The occurrence of occasional isolated variants as mentioned in the literature cited and as observed by the writer could be caused by "normal" mutagenic processes to which organisms everywhere are exposed. Their rare and isolated appearance is the situation to be expected; it is not necessary to postulate an abnormal environment as the causative agent. Deposits of radioactive minerals constitute "environment" in a very special dual sense. The effects of radiation on the organism may in certain cases be only physiological, e.g., inhibition of normal growth and development or even favoring growth as reported by Cannon (1957, p. 475, 481), Sparrow and Pond (1956, p. 132), and others. This effect results in the production of transient forms that may be equated with ordinary climate or edaphic variant forms which are not within the scope of taxonomic consideration. On the other hand, the variants produced by natural radiation mutagens resulting in genetic change are not in the same category as the former, but could be considered for taxonomic recognition of a low rank.

Isolated variants are expected to be the result of recessive mutant genes, which in a population of normal dominant alleles would attain phenotypic expression only rarely until sufficient time had elapsed to permit the recessive mutant gene to be widely distributed through the population. This is a slow process, for even though the mutation does not reduce the competition potential of an individual, the disparity in proportion of diaspores of normal versus mutant forms increases greatly with the distance from the original mutant. Thus the mutant form would tend to be "smothered" by the predominant normal form by sheer force of numbers of new seedlings in the restricted areas available for invasion and ecesis that occur in an essentially "closed" community. It can scarcely be imagined that the type of variation discussed in this study could give a competitive advantage to those individuals having it.

The great variability within the limited area of the Port Radium uranium deposits can be explained by the increased mutation rate due to more radiation dosage than at other sites having only "background" dosages. The possibility of identical gene mutations having occurred at different times is not remote, for mutations occur more often in some directions than in others. It is known that many genes mutate to a certain allele more frequently than to another. This accumulation of numbers of mutant recessives greatly increases the chance of large numbers of homozygous recessives appearing in the population and of the mutant genes being rather quickly dispersed throughout this area of very limited extent. These individuals may soon outnumber the normal dominant homozygous types. A colony of clones could therefore be produced which would show the areal intensity of variation observed in the Port Radium colony, and be perpetuated indefinitely by clonal offshoots.

The concentration of variants found here definitely indicates the location of the radioactive ore that is present. Geobotanical interpretation of variation in a species must depend on the greater-than-average frequency of occurrence in a localized area, and is thus analogous to geochemical evaluations which depend on anomalous values based on an established background value. Therefore

the geobotanical prospector must have a conception of variation frequencies of a certain species, even though it may not be possible to reduce it to quantitative values because of the vast range of many species, and insufficient observations. These variations, however, can be adequately expressed by rather subjective terms such as "rare," "infrequent," "common," or "abundant." Where frequency of occurrence of variants begins to become apparently greater than this conception of normal frequency, environmental factors may be causative suspects. Where frequency of occurrence is areally concentrated far in excess of the conceptual norm, edaphic peculiarities are strongly indicated. Where variants of a definite character are produced experimentally by definite edaphic modifications, the geobotanical relationship is proven. This latter procedure was followed by Cannon (1957, p. 415) in "salting" soils with radioactive agents. Naturally occurring variation in a species can be of use to geobotanical prospecting only if these relationships are properly evaluated.

Numbered specimens referred to in this paper were presented to the Herbarium, University of Michigan, Ann Arbor. The writer wishes to acknowledge the encouragement and helpful criticism of the late Professor H. H. Bartlett, Department of Botany, University of Michigan, who was the director of the Port Radium Expedition. He also wishes to express appreciation for the advice and assistance of Dr. William C. Steere, the leader of the field party on this Expedition. The support given by the Office of Naval Research, U.S. Navy, is gratefully acknowledged. Appreciation is extended to the Director, U.S. Geological Survey, for permission to use material acquired while the writer was employed by this agency. Dr. William S. Benninghoff, Department of Botany, Dr. Rogers McVaugh, Curator of Phanerogams, and Mrs. Jennie V. A. Dieterle, Herbarium Botanist, all at the University of Michigan, are also thanked for their assistance in this study.

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AN EXTENSION IN THE BREEDING RANGE OF BREWER'S BLACKBIRD IN ONTARIO

O. E. DEVITT
83 Harding Blvd., Richmond Hill, Ontario

IN CANADA PRIOR TO 1943, Brewer's Blackbird (*Euphagus cyanocephalus*) was considered a bird of the western provinces. Taverner (1934) in *Birds of Canada* gives its range as "from Manitoba west to the coast". In adjacent mid-western American states a definite eastward movement by this species has been noted since early in the present century (Lyon, 1930; Roberts, 1932; Schorger, 1934; Mayfield, 1949). Bent (1958) says "the Brewer's Blackbird seems to have extended its range eastward in recent years, and it has now been recorded as a breeding species in Ontario, Eastern Minnesota, Wisconsin and Illinois". Walkinshaw and Zimmerman (1961) state that during the twentieth century it has "extended its breeding range eastward – to central, and possibly eastern, lower Michigan".

The purpose of the present paper is to review the status of this species in Ontario and to document an eastward extension in breeding range of 143 miles in 1962 and a further eastward extension of seventy-eight miles in 1963, as well as to record intermediate summer occurrences hitherto unreported.

A male collected for the Royal Ontario Museum of Zoology by Clifford E. Hope at Lake Attawapiskat in northern Ontario on June 5, 1939 marked its first reported occurrence in Ontario (Baillie, 1953). This remained the only record until Dr. A. E. Allin observed a small male blackbird with straw-coloured eyes at Port Arthur during the summer of 1943. On June 13, 1945,

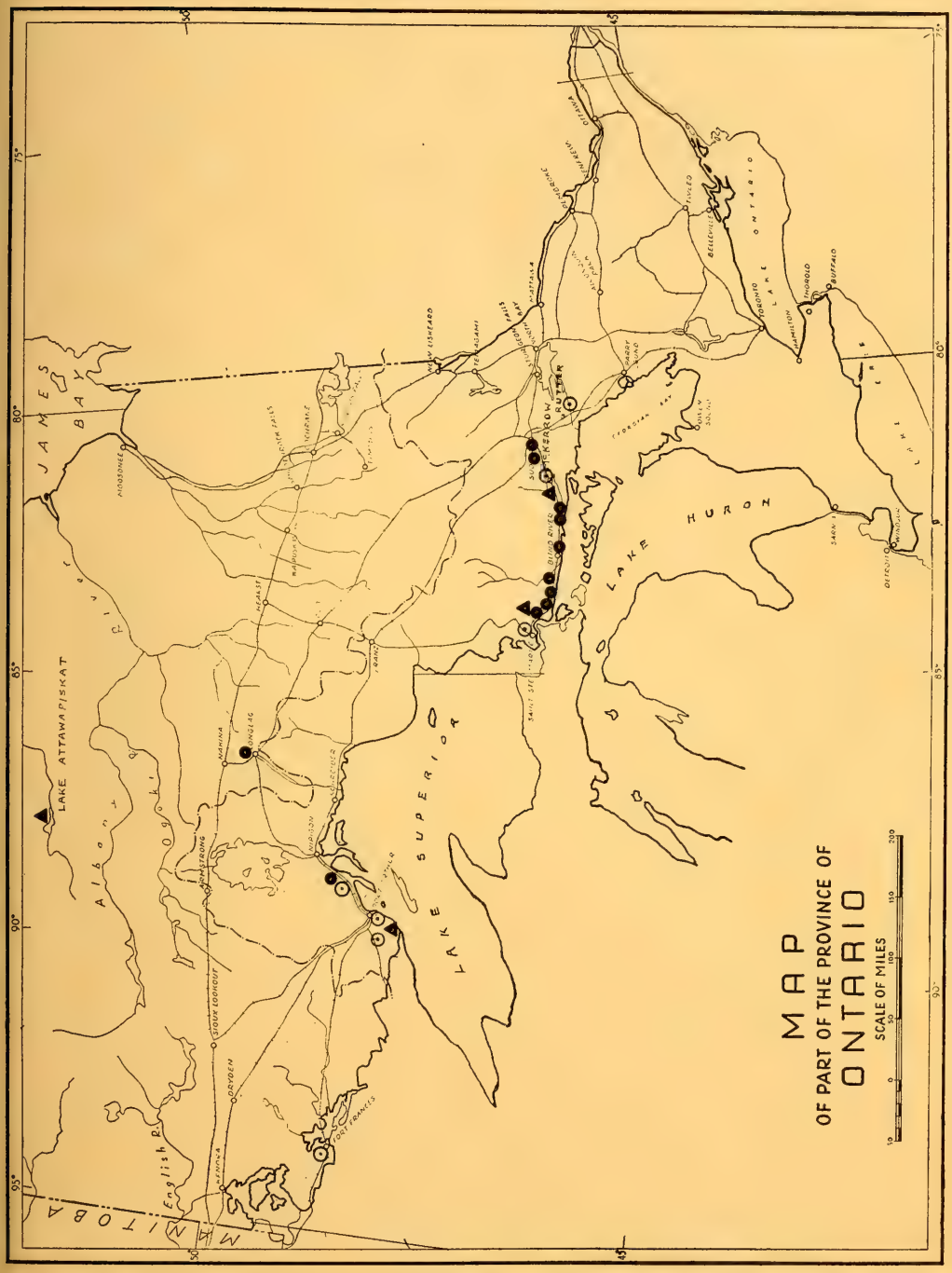

FIGURE 1. Summer records of Brewer's Blackbird in Ontario. Large dots indicate locality records; circled dots are where the species has been known to nest. Triangles designate where specimens have been taken.

a colony of at least eight birds was found in the same locality, a cleared area, eight acres in extent, by Allin and Dear (1947). A male was collected on June 14 and L. S. Dear found a nest containing four young to establish the first breeding record for Ontario.

The twelve Brewer's Blackbirds recorded by Walkinshaw and Zimmerman (1961), as having been seen by E. E. Kenaga on September 1, 1948 at Longlac, were probably early fall migrants.

Allin and Dear located a second colony of Brewer's Blackbirds in Paipoonge Township, Thunder Bay District, in 1952 but could find no nest (Baillie, 1953). In 1955 a nest with five eggs was found there by Dr. MacLaren on June 5 (Allin and Denis, 1955). By 1955, the species was established in summer in five areas around the Lakehead (Baillie, 1955).

Brewer's Blackbirds have nested in a willow-grown muskeg area at Fort Frances, Rainy River District, since 1951 according to Leslie Patterson (Baillie, 1961). They remained until 1957 when the immediate area was burned over. Mr. Patterson saw adults feeding newly-emerged young on several occasions.

Further evidence of an eastward movement in Ontario came to light when Dean Amadon and Jeff Carleton, en route home after attending the Wilson Ornithological Club meeting at Douglas Lake, Michigan, saw a pair near Garden River, half way between Sault Ste. Marie and Echo Bay, June 17, 1953 (Baillie, 1953). By coincidence, the writer, his wife and D. S. Miller returning from the same meeting two days later (June 19) also saw a pair of Brewer's Blackbirds along No. 17 Highway near Echo Bay.

At Sault Ste. Marie, Dr. and Mrs. J. M. Speirs and William Morris found a nest containing four young on June 6, 1954. Mrs. Speirs located two more nests on June 11 (Speirs, 1954). A fourth nest with five eggs and a fifth nest containing well-developed young was discovered a few days later by D. M. Wood in the same colony, which was located at the eastern city limits of Sault Ste. Marie in a quarter-mile stretch between the highway and the railway (Wood, 1955). At Echo Bay, fourteen miles east of Sault Ste. Marie, two more pairs were known to be resident, but breeding evidence was restricted to adults carrying food to young and carrying away excretory pellets. A careful search failed to reveal the young (Speirs, 1954). One bird seen seven miles east of Thessalon on July 31, 1959 and another at Blind River on August 4 of the same year have been recorded by Speirs (1959).

On July 1, 1962, a small colony of five pairs of Brewer's Blackbirds was discovered by the writer and his wife at the easterly outskirts of McKerrow, in Baldwin Township, Sudbury District, 143 miles east of Sault Ste. Marie. The birds were frequenting a narrow band of territory between the railway and Highway No. 17. A search disclosed two young birds, out of the nest, but as yet unable to fly. The young were easily captured, photographed and released. A dead female that had been hit by an automobile on the highway was recovered and sent to the Royal Ontario Museum. The writer had occasion to travel the same highway on August 11, 1962 and noted Brewer's Blackbirds at the following points: Echo Bay, 3; Blind River, 4; McKerrow, 16. The following day a group numbering twenty-five was noticed at the westerly limits of Copper Cliff to mark their most easterly observed occurrence for that year.

While en route to Sudbury on May 31, 1963 to check for possible nesting sites of Brewer's Blackbirds, the writer and his wife were surprised to come upon two pairs at Rutter, thirty-seven miles south of Sudbury, in Bigwood Township, Sudbury District. After watching the actions of the birds for half an hour, we decided that they must be nesting in a marsh alongside Highway No. 69. After a short search we flushed a female from a nest of five eggs. The well-built nest of grasses and rootlets was placed in the centre of a clump of dried rushes, approximately fifteen inches above the water of the marsh. The outside diameter of the nest measured six inches while the inside width was four inches. The nest and eggs were collected and sent to the Royal Ontario Museum. With the exception of a small stand of narrow-leaf cattail (*Typha angustifolia*) near the road and a few *Spiraea* sp. and red-osier dogwood (*Cornus stolonifera*) bushes around its borders, the marsh occupied by these birds consisted of almost pure *Scirpus cyperinus* (L.) Kunth. and covered approximately ten acres. A dense growth of alders (*Alnus* sp.) and willow (*Salix* sp.) grew along the west and north sides of the marsh.

Besides the Brewer's Blackbirds other birds noted in the immediate vicinity were the Short-billed Marsh Wren (*Cistothorus platensis*), Yellowthroat (*Geothlypis trichas*) and Traill's Flycatcher (*Empidonax traillii*).

Rutter is seventy-eight miles east of McKerrow, the previous most easterly breeding locality for this species.

The Copper Cliff area was re-examined on June 1, 1963, and about one half mile west of the town two pairs of Brewer's Blackbirds were found that showed strong attachment to a small cattail marsh along the railway tracks. One pair, in particular, protested our intrusion but no nest was located. The behaviour of the birds indicated probable nesting.

About five miles farther west along Highway No. 17 and approximately one mile west of the intersection of Highway No. 536 to Lively, we saw a male Brewer's Blackbird gathering a beakful of insects.

At McKerrow, on the same day at least five pairs were again occupying a quarter-mile stretch of territory adjacent to the highway. Three nests were located, all built on the ground in low cover. The nests were made of fine sticks and grasses and lined with fine rootlets. In size they averaged six inches outside width, with a cup four inches in diameter and a depth of two inches. The first nest contained four newly-hatched young plus one egg. It was half-hidden beneath dead bracken (*Pteridium aquilinum*) and a small *Spiraea* sp. A second nest, which held five young about a week old, was located about one hundred yards to the east of the first nest; a third nest contained five eggs. Two other pairs were definitely on territories and apparently nesting but the actual nests were not located.

Vegetation surrounding the three nests was essentially the same and, besides bracken and spiraea, consisted of wild strawberry (*Fragaria* sp.), wild raspberry (*Rubus* sp.), blueberry (*Vaccinium* sp.), *Aster* sp., goldenrod (*Solidago* sp.), fringed polygala (*Polygala paucifolia*), false lily of the valley (*Maianthemum canadense*), ground pine (*Lycopodium obscurum*), willow (*Salix* sp.), common yarrow (*Achillea millefolium*) and sweet fern (*Myrica asplenifolia*). Across the highway from the nesting colony was a large alder

(*Alnus* sp.) thicket which was used to some extent by the blackbirds as perching sites, although the preferred lookout seemed to be the telephone wires.

An additional breeding locality was discovered by the writer on July 1, 1963 in MacGregor Township, Thunder Bay District at the junction of Highways No. 17 and No. 587, near Pass Lake. At least four pairs were occupying wet grassy fields bordering the highway. Two nests were located in low vegetation on dry knolls. Both were sunken in depressions so that their tops were flush with the ground. One contained three young about a week old, plus one egg; the other had four small young and an unhatched egg. This area is twenty-three miles east of Port Arthur.

As an indication of the remarkable increase in numbers of this western species in Ontario, the writer observed them in thirteen different localities between Sault Ste. Marie and Sudbury along Highway No. 17 on July 6, 1963, in groups of up to eight birds.

In view of a similar rapid eastward spread of Brewer's Blackbird in the United States, especially in the Lower Peninsula of Michigan, it should be looked for in the lowlands of the Lake St. Clair-Windsor region of Ontario.

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REPORT OF COUNCIL TO THE EIGHTY-FIFTH ANNUAL MEETING OF THE OTTAWA FIELD-NATURALISTS' CLUB

December 3, 1963

During the past year, five meetings of Council were held at the National Museum of Canada: December 12, 1962, February 28, May 23, October 8 and November 12, 1963. The average attendance was seventeen members. The Club's business was conducted in the usual orderly manner.

Appointments for 1963 were made as follows:

Editor, The Canadian Field-Naturalist — F. R. Cook
Business Manager, The Canadian Field-Naturalist — W. J. Cody
Chairman, Publications Committee — D. D. Hogarth
Chairman, Excursions and Lectures Committee — G. R. Hanes
Chairman, Reserve Fund Committee — H. Lloyd
Chairman, Membership Committee — F. H. Schultz
Chairman, Bird Census Committee — G. H. McGee
Chairman, Macoun Field Club Committee — F. R. Cook
succeeded by A. H. Clarke, Jr. in April, 1963
Chairman, F.O.N. Affairs Committee — R. Frith
Chairman, Public Relations Committee — E. L. Bousfield
Chairman, Preservation of Natural Historic Sites Committee — W. K. W. Baldwin
Chairman, Mer Bleue Conservation Committee — D. A. Smith
O.F.N.C. Representative to A.A.A.S. Council — V. E. F. Solman

At its February meeting, Council elected Mr. Stuart Criddle, longtime Prairie naturalist now residing in Sidney, B.C., as an Honorary Member of the Club. He joined the illustrious company of previously elected Honorary Members, Dr. Alice Wilson, Mr. Herbert Groh, Dr. Harrison F. Lewis and Dr. George H. Turner.

Report of the Publications Committee

Since the last report of Council, five numbers of The Canadian Field-Naturalist have been published. These included the last two numbers of Volume 76 which contained 112 pages, and the first three numbers of Volume 77 which contained 182 pages, or a total of 294 pages in all. Papers, notes and reviews were distributed as follows:

	Papers	Notes	Reviews
Botany	5	6	5
Entomology		2	2
Geology	1		
Herpetology	3	6	2
Ichthyology		3	3
Malacology		1	
Mammalogy	3	4	5
Ornithology	6	19	5
Miscellaneous	2	1	6

The editor has reported that Volume 77, No. 4 is in an advanced state of preparation and should be published shortly. Some manuscripts are on hand for the first two numbers of Volume 78, but he would welcome more good contributions.

Expenditures for the year were as follows:

Volumes 76 (Nos. 3 and 4) and 77 (Nos. 1, 2 and 3)	$4,469.12
Binding of official Club set of THE CANADIAN FIELD-NATURALIST	36.00
Reprints for volumes 76 (Nos. 2, 3 and 4) and 77 (No. 1)	676.21
Total	$5,181.33

REPORT OF THE EXCURSIONS AND LECTURES COMMITTEE

The Excursions and Lectures Committee met three times and arranged: four lectures (of which one was co-sponsored by the National Museum of Canada), a film night, six daytime and two evening field trips, four morning bird walks and the annual dinner. Six Newsletters were issued. The first of a winter series of six bird identification lectures for beginners was recently presented by Mr. George McGee and evoked considerable interest.

Approximately ninety people attended the annual dinner at the Experimental Farm, and heard a most interesting talk entitled "Birds and Men" given by Dr. D. A. Munro.

The Newsletter now appears under a printed letterhead designed by Mrs. G. R. Haynes. The Committee purchased a supply that should last about three years.

REPORT OF THE RESERVE FUND COMMITTEE

There has been no change in the Club's investments during the past year.

REPORT OF THE MEMBERSHIP COMMITTEE

The committee distributed information on Club activities and solicited new memberships. Of forty-two new individual members, thirty-five were active members and seven associate members. In addition twelve institutions were added as subscribers to the Club journal. No expenses were incurred.

REPORT OF THE BIRD CENSUS COMMITTEE

The forty-fourth consecutive Annual Christmas Bird Census was held by The O.F.N.C. on Sunday, December 23, 1962. Forty observers in thirteen groups reported a total of 5,375 birds of forty-five species. While the count was down slightly from the 6,310 birds of forty-eight species reported in the 1961 Census, two new birds, Common Loon and Loggerhead Shrike, were added to our all-time list which now stands at eighty-nine species.

The details of the Census were published in the Christmas Census edition of *Audubon Field Notes* and, in addition, were circulated to local members in a Newsletter.

REPORT OF THE MACOUN FIELD CLUB COMMITTEE

In terms of total membership, apparent interest of the members in club activities and in other developments, the 1963 Macoun Field Club season has been an outstanding success. Attendance at meetings has nearly doubled,

innovations in club activities have met with enthusiasm, and the administrative personnel of the club has been increased from one to three. In addition to sponsorship by The Ottawa Field-Naturalists' Club, the Macoun Club has now become an official administrative responsibility of the National Museum of Canada and is therefore doubly assured of year to year stability.

Regular meetings of the club have been held throughout the year except for the period from May to September. In April, a newspaper report on the Macoun Club with coloured photographs was published nationally and much additional interest was engendered. Attendance, which averaged forty-five for all three sections in the spring, increased to an average of eighty-five in the fall. Three field trips were held in May, to Hogs Back and Mer Bleue in Ottawa and to Fitzroy Harbour Provincial Park in Fitzroy Harbour, Ontario. Attendance on these trips averaged fifty-eight, with many new members participating.

Speakers at the Macoun Club during 1963 were as follows: F. R. Cook, D. J. Damas, A. D. DeBlois, H. B. Herrington, S. D. MacDonald, W. W. Mair, W. R. M. Mason, J. R. McLintock, H. Monahan, V. E. F. Solman, and J. S. Tener. In addition, Dr. Alice E. Wilson gave a fine series of lectures on the geology of the Ottawa area.

Officers for 1963-1964 are as follows: *Senior Group*, President Robert Bender, Secretary John G. Robertson, Attendance Paul Valentine, Observations Clair Suddon; *Intermediate Group*, President David Smiley, Secretary Arthur Clarke, Attendance Derek Munro, Observations Susan Young; *Junior Group*, President Peter Teal, Secretary Chris Fyles, Attendance Colin Barnard, and Observations Don Beckett.

In April, A. H. Clarke, Jr. replaced F. R. Cook as Macoun Club Chairman and in the fall the National Museum assigned two staff members, Messrs. A. A. Ellis and G. Tessier, as assistants. In addition, the club is continuing to benefit from the dedicated assistance of Mr. Herbert Groh. Further assistance has enabled additional services to be given such as renovation of the club's collection of natural history objects, more assistance to members in conducting projects, assistance with film projection equipment, etc.

REPORT OF THE F.O.N. AFFAIRS COMMITTEE

The committee during November and December has supervised the usual sale of Christmas Cards and stationery purchased from the Federation of Ontario Naturalists and re-sold for the benefit of our Club.

There are no official joint activities of the two organizations to report. Major Federation functions, usually held in Toronto or points west, had present on most occasions a small number of members of the O.F.N.C.

REPORT OF THE PUBLIC RELATIONS COMMITTEE

At the request of council members, the committee was active in developing publicity for the Mer Bleue Project and forwarding news-worthy items to the Ottawa press.

REPORT OF THE PRESERVATION OF NATURAL HISTORIC SITES COMMITTEE

The Committee met once to discuss the preservation of the Mer Bleue peatland. A report on this subject, with recommendations for action, was presented to Council. The Committee co-operated with the Excursions and Lectures Committee and the *ad hoc* Mer Bleue Conservation Committee to present to Club members at the regular meeting in March a program of activities designed to further this project. Later the Committee co-operated with the Editor of The C.F.N. in planning a series of scientific papers to be written by interested scientists on various aspects of the Natural History of the Mer Bleue.

No meeting of the Citizens' Committee for Preservation of Historic Sites was held during 1963.

REPORT OF THE MER BLEUE CONSERVATION COMMITTEE

This *ad hoc* committee was set up early in 1963 to co-ordinate a variety of Club activities to be held under the auspices of other committees—all with the aim of expressing the urgency for preserving the Mer Bleue Peat Bog and taking steps to further its preservation. This Committee co-operated with others in arranging and participating in the special Mer Bleue meeting in March and a successful field trip to Mer Bleue in June. Moreover, it assisted in stimulating the efforts of individuals, both within and outside the Club membership, to begin synthesizing our present knowledge of the bog and its inhabitants into a series of papers to be published in The Canadian Field-Naturalist.

Largely as a result of correspondence with the Club, a meeting of representatives of organizations interested in the Mer Bleue was convened in April by the National Capital Commission. At this exploratory meeting, a Technical Committee of which our retiring President is Chairman, was set up to give advice to the National Capital Commission on matters concerning multiple use of the Mer Bleue in its natural state as part of the Green Belt. The whole situation is currently under study and the committee is hopeful of a satisfactory outcome of its actiivties.

DONALD A. SMITH, *Secretary*

STATEMENT OF FINANCIAL STANDING
The Ottawa Field-Naturalists' Club, November 27, 1963

CURRENT ACCOUNT

Assets		Liabilities	
Balance in bank, Nov. 27, 1963	$2,911.91	Cheques outstanding	$ 343.35
Cash on hand	22.20	Balance	3,190.01
Bills receivable, separates	599.25		
	$3,533.36		$3,533.36

Receipts			Expenditures	
Balance in bank, Nov. 29, 1962		$2,868.32	Can. Field Nat. 5 numbers	$4,505.12
			Separates and illustrations	676.21
			Editor's honorarium	200.00
Fees:			Business Manager's honorarium	100.00
Current	$2,860.54		Newsletter	78.26
Arrears	139.00		Excursions and Lectures Committee	52.25
Advance	273.40		Macoun Field Club	113.75
Associate	78.00		F.O.N. affiliation	45.40
		3,350.94	Postage and Stationery	188.31
Separates and illustrations		1,994.13	Bank discount	33.00
Sale of back numbers		280.89	Miscellaneous	48.48
Miscellaneous		137.26	Bank balance Nov. 27, 1963 plus cash on hand less cheques outstanding	2,590.76
		$8,631.54		$8,631.54

RESERVE FUND

Assets		Liabilities
$3,000 Ontario Hydro 3% Bonds, market value	$2,737.50	
20 shares Bell Telephone Stock, market value	1,065.00	NIL
Balance in bank Nov. 27, 1963	411.43	
	$4,213.93	

Receipts		Expenditures	
Balance in Bank Nov. 29, 1962	$273.77	Safety Deposit Box	$ 5.00
Bank Interest	8.66	Bank Balance Nov. 27, 1963	411.43
Bond Interest	90.00		
Bell Telephone Dividends	44.00		
	$416.43		$416.43

PUBLICATIONS FUND

Assets		Liabilities
$1,500 Ontario Hydro 3% Bonds, market value	$1,353.75	
Balance in bank Nov. 27, 1963	292.97	NIL
	$1,646.72	

Receipts		Expenditures	
Balance in bank Nov. 29, 1962	$240.72	Bank Balance Nov. 27, 1963	$292.97
Bank Interest	7.25		
Bond Interest	45.00		
	$292.97		$292.97

Audited and found correct (Signed)
R. J. Moore J. M. Gillett, Auditors

(Signed) Anne Banning, Treasurer

REVIEWS

Never Cry Wolf

By Farley Mowat. McClelland and Stewart, Toronto. 247 pages. $4.95.

The reason I was asked to review this book, I suspect, was that the editor knew I had worked closely with the author in the North. Farley refers to me as a school chum he had known in more carefree days. A glance at the dust cover forces the incredible admission that I knew him as a beardless youth! During the period dealt with in the book Farley was assisting me on the preliminary caribou investigation conducted by the Canadian Wildlife Service in 1948-9. But his career with the Federal Government lasted only about six months. As the reader is well able to confirm, Farley wasn't cut out to be a civil servant. Since his retirement he has gone on to greater heights and written three semi-fiction books based upon his experiences with the caribou investigation crew.

These books are a fascinating mixture of fact and fancy with the central theme of the ineffectual, bumbling civil servant trying to cope with Mowat's raw north. This theme finds ready acceptance among his uninformed readers who cherish the same point of view. *Never Cry Wolf* has been heralded as hilariously funny—and it is, especially to the few of us who were involved in the episodes described by "Squib" in the early chapters. With a fair share of malice and considerable literary licence with the facts, he caricatures us and parodies the Canadian Wildlife Service. Most of us are recognizable through our thin disguises. Lance-Corporal J. Smith is undoubtedly Dr. Dean Fisher and his banishment to study sticklebacks on Ellesmere Island is a reference to his later leadership of the Arctic Unit of the Fisheries Research Board. I am not so sure of the "Chief", who clacked ground-hog jaws at Squib. Dr. Harrison Lewis was then Chief of the Canadian Wildlife Service. Since he is a distinguished ornithologist, I suggest that a room full of pickled cormorant stomachs would have been more appropriate. But, if it is I, as Chief Mammalogist, who is caricatured, I must protest that I have never given the dentition of *Marmota monax* more than a casual glance. As for joining the federal service in 1897,—I suspect that we just looked that much more mature to Squib.

One caricature I do deplore is that of Gunnar Ingebritson, of Arctic Wings Ltd., who flew him from Churchill to Nueltin Lake. Gunnar was one of that colourful band of bush pilots, which served our Arctic frontier with verve. He effected several exciting rescues, including that of the crew of an American Air Force plane forced down on the shifting ice floes of Hudson Bay. He lost his life tragically a few years later in an Arctic crash. Gunnar's real life was far more exciting than Farley's shallow caricature.

On the lighter side, however, I found Farley's comments on our post-war military phase quite incisive. I wonder what he would say about our latest phase of wearing berets and ceintures flêchées! His description of us as Dantesque bureaucrats doesn't seem appropriate: I always pictured us as Caspar Milquetoasts!

At the risk of being considered pedantic and mundane, I would like to set the record straight on those events so the reader can appreciate the full measure of Squib's humour. Farley was only one of three biologists who assisted in the caribou survey and as he has emphasized, he was assigned the problem of assessing the effect of wolf predation upon the caribou. I prepared the field instructions which are generously ridiculed in the book, or else given sympathetically as his own program. Mowat's suggestion that he was

hired to produce incontrovertible proof to damn the wolf is a woolly fabrication of fact. I am sure his disclosure will come as a shock to those few extremist members of the hunting fraternity who have been condemning the same Service vehemently for years as apologists for predators and wolf-lovers.

He reports that he was hired at the munificent salary of $125 a month. Actually he was hired as a technical officer, grade 1, at $175 a month, which was the established scale for a second year Arts student in May, 1948. He submitted a very long list of equipment and supplies which he required, and it was filled. This included a folding boat, along with an eighteen foot canoe, tents, outboard motor, axes, alcohol, smoke generators, etc. and etc. If he had any complaints concerning the equipment and supplies—they were largely due to his own choice.

Mowat's description of the start of his field work is completely fanciful. He and Andrew H. Lawrie flew from Ottawa to Churchill in an R.C.A.F. Dakota. I met them at the Churchill airport, since I had been there six weeks carrying out an aerial survey of the migrating caribou. Arrangements had already been made to rent Fred Schweder's cabin at Windy Bay, Nueltin Lake, Keewatin District, for $15 a month (not $10 for three months) to serve as a base to store their equipment (they planned to tent and travel extensively by canoe). However, as Farley states they occupied the cabin much of the summer and an adjustment was later made on the cabin rent. It should be noted that Squib was never "alone with the wolves". Andrew Lawrie, a graduate biologist, was his constant companion all summer and nominally in charge of the party.

Prior to their arrival, Gunnar, Charlie Weber (the engineer) and I had flown to Nueltin Lake, taking much of their heavy equipment such as canoe, outboard motor and a cache of gasoline. Even then, when they were finally flown in the load taxed the carrying capacity of their *Norseman* aircraft. (The last JU.52, trimotor to fly in Canada was scrapped in 1947). I might also point out that the Moose Brand Beer served in Churchill must have packed quite a punch in order for Squib to rush out of the beer parlor and catch hold of the wing of the aircraft landing at the skiplane base *five miles away!*

The character of Mike is based upon Charlie Schweder. He met Farley in 1947, when Farley first visited Nueltin Lake. Any reticence on Charlie's part was probably based upon his experience with Mowat the year before.

Of course Mowat's various messages in italics and capitals are sheer bunk! He was supplied with a Forestry-type radio transmitter (with extra batteries). Farley and I set up the radio and tested it at Churchill before they departed. With it they communicated with Churchill Signals until about mid-August when it became unserviceable and was flown out for repairs on one of the regular service flights. The Department exchanged with Mowat several radio messages and mailed reports during the summer. It had no reason to doubt his location unless it was when Mowat flew out to Toronto and gave a press interview. (The call letters assigned to the transmitter by D.O.T. were CF6E—rather prosaic compared to "Daisy Mae").

As Farley states he submitted a report upon his studies. However, there is nothing in the style, spelling, or grammar of this report to foretell that it would some day form the basis of a "best seller". I abstracted the report and published the highlights in the preliminary barren-ground caribou report of 1951, crediting the observations to Mowat. He now borrows several of my conclusions from that report such as the importance of human utilization of the caribou including the annual human kill of 100,000 animals (which I reported in 1951, without losing my C.S. "head").

During Mowat's "indoctrination" period in Ottawa, he was given several books to read including Adolph Murie's *The Wolves of Mount McKinley*, 1944.

Any resemblance between *Never Cry Wolf* and that book is *not* coincidental. Much is familiar, including first names for the wolves and the crawl into the burrow. Squib disproved no scientific concepts about wolves—only his own misconceptions. Instead he sets up his own straw men to bowl over. For instance, an estimate of 36,000 wolves was published by C. H. D. Clarke, in 1940, for the total caribou range of 600,000 square miles, not just of Keewatin District. Wolf bounties have not been paid in the N.W.T. for many years and were discontinued in the Prairie Provinces prior to 1954. There is no "official" book which says wolves do not bark.

Farley gives a hilarious description of his struggle with the use of the Raunkiar's Circle in range studies. It is evident that he lacked the equipment and training to do any nutritional analysis in the field and was not asked to do it. He literally interprets the word "throw" in spite of the detailed instructions that the frequency data were to be collected on systematic transects at intervals of ten paces. The situation is comparable to the technician at a satellite launching pad, tearing out the control panel when the monitoring officer exclaims, "All systems go!". A recent Civil Service pamphlet, which outlines career opportunities for biologists, includes a photograph of two young biologists, on their hands and knees, staring at a Point Sampler, while conducting range studies in Wood Buffalo Park. It appears therefore that such studies are still in style for biologists. Farley was, therefore, well advised to recognize his limitations in biological research potential and to seek fame elsewhere.

Mowat also curiously telescopes time in his book. Considering the life expectancy of a wolf, it is extremely doubtful that George, Angelina and Uncle Albert would still be around in May, 1959, eleven years after his visit in 1948, when they appeared to be in the prime of life. In the meantime there were several developments which influenced wildlife management programs in northern Canada. First of all there was the unprecedented outbreak of rabies among wolves, coyotes and foxes. Then there was the continued decline of the caribou herds. These natural catastrophes necessitated immediate co-operative action as outlined in my article in the Spring issue, 1956, of *The Beaver*. A broad caribou management program was initiated which placed primary emphasis on reducing the human kill by tightening regulations (such as the prohibition of sport hunting). A part of this program was the introduction of limited wolf control (not eradication) by trained wolf hunters instead of the ineffective bounty system. Wolf numbers were reduced: the rabies epizootic subsided: and the crop of caribou fawns jumped dramatically. Since 1959 the wolf control program has tapered off. This is the background of Mowat's fanciful Epilogue. The facts are that two control stations were established on Windy Lake, 27 and 30 miles southwest of "Wolf House Bay" during the autumn of 1958. On April 10, 1959, these sites were visited, records of the wolves taken and biological information were gathered and the stations destroyed. No cyanide "wolf getters" were employed in the District of Keewatin.

Much of the book consist of a fascinating embellishment of Mowat's observations on the home life of a wolf pack. It is certain that not since Little Red Riding Hood has a story been written that will influence the attitude of so many towards these animals. I hope that the readers of *Never Cry Wolf* will realize that both stories have about the same factual content.

A. W. F. BANFIELD

National Museum of Canada
Ottawa, Ontario

Wildlife's Ten-Year Cycle

By LLOYD C. KEITH. Madison, University of Wisconsin Press, 1963. 16 + 201 pp. $6.00 (U.S.).

Dr. Keith's book is in the main a review of literature bearing on the occurrence and characteristics of the ten-year mammal and bird cycle. The subject is one of great interest in Canada, for many of its most striking examples come from the records of the fur trade in our boreal forests. Furthermore, the cycle strongly influences the lives of many Canadians, from trappers to ammunition salesmen. As well as providing a survey of data, the book presents several interesting and original contributions, and an extensive bibliography.

The book was written in order to provide background material for cycle studies and to point up promising research topics. Available kinds of data are evaluated, ranging in sophistication from fur returns to the capture-recapture census. A technique is demonstrated for calculating fiducial limits around mean intervals in serially correlated series of random numbers, the series being of various lengths. If the mean interval of a series of census figures of comparable length lies outside the confidence limits given (98% and 95%), the series is considered non-random, or cyclic in the strict sense. By means of this technique evaluations are made of census figures on the local, regional, and continental levels in the New and Old Worlds.

The criterion of synchrony is adopted as of great importance in the validation of cycles; "strict regularity" is abandoned as a criterion, and the term "ten-year cycle" is retained as "a useful description of the non-random long-term fluctuations" of certain North American furbearers and gallinaceous birds, and the snowshoe hare. The latitudinal and otherwise geographical progression of continental cycles is discussed, as is the order of amplitude of well-studied examples. Other characteristics of cycles and of cycling populations reviewed include reproduction, mortality, population structure, pathology, and behaviour.

The last chapter is a review of the various explanations that have been proposed to account for the ten-year cycle. The series of population estimates upon which the generalization rests are not equivalent to serially correlated random number series, and the well-known hypothesis of Palmgren and Cole must therefore be rejected. Postulated meteorological influences have the merit of explaining the synchrony so important in the earlier review; when sought, however, they cannot be found, or, if found, they cannot be related convincingly to the species concerned. Various theories including those implicating predator-prey and relaxation oscillation are examined. In conclusion, Keith states that he is "convinced, and assuredly many others are as well, that none of the foregoing hypotheses can adequately account for the ten-year cycle", and proposes a long-term, comprehensive field study by a diversified team of specialists.

Most students of cycles have been convinced of their general validity by certain very impressive series of population indices, notably lynx pelt returns of the Hudson's Bay Company. Field work, however, has failed to establish a universal cause for the declines observed and has even given indications that the conspicuous causes, pathological conditions, for example, may be relatively unimportant. Cycles observed in laboratory populations seem to have little direct relevance to those studied in the field, and Keith makes no attempt to fit the ten-year cycle into the formal ecological framework that has been constructed around the laboratory data. There is no discussion of the nature of an oscillatory biological system. Hutchinson's observation, from a symposium (1954, Journal of Wildlife Management 18) to which reference is made, that a population might "resonate" by virtue of its intrinsic characters such as life history chro-

nology, to one or a combination of subtle environmental frequencies, was perhaps considered too general for inclusion. Similarly the views of Dunbar (1960, American Naturalist 94) on the instability of immature ecosystems were not discussed. A hypothesis recently put forward by Chitty (1960, Canadian Journal of Zoology 38) relating the four-year vole cycle to a postulated general autoregulatory capacity of animal populations may have application to the ten-year cycle and should pehaps have been mentioned.

In my opinion a major short-coming of Keith's approach is his apparent rejection of earlier contributions to the problem of cycles. Surely each piece of research on the ten-year cycle, and each contribution to the conceptual side of the problem, has left certain questions unanswered and certain hypotheses untested. It would seem unfortunate to abandon the patient, particulate unravelling of the problems involved along the lines already begun in favour of a totally new start. Modern experimental methods in ecology have perhaps barely had time to prove themselves wanting in the answering of the many questions remaining.

The nature of the evidence for the validity of the ten-year cycle is such that a completely nonpartisan book might be impossible to write: the phenomenon, for example, seems confined to certain species within a certain area, and it is difficult not to introduce a bias when selecting the reports to be evaluated. The scepticism of the reader is nonetheless occasionally aroused by such statements as "when the effects of extensive habitat restoration schemes and regulated trapping . . . are added to the profound influences of adverse water conditions, snowfall, etc., . . . it is, I think, surprising that any semblance of regularity should still prevail" (pp. 43-4), or, "There is perhaps still a suggestion of a cycle in the Ontario data" (p. 50). A reference to a discussion by Lack of the adrenopituitary exhustion hypothesis is infelicitous: "only as long as such mortality does not in the long run have survival value" (p. 112), harking as it does to the no-man's land of population selection.

In conclusion this book can only be welcomed. It is attractively produced and well written. It provides a concise summary of cycle research and available census series, and a very useful bibliography. North American cycle research is once again, with the development of modern techniques and concepts, an attractive field of study, as it was when Clarke and MacLulich made their famous contributions. The orderly addition to our knowledge of population regulation in wild species will undoubtedly in time make possible an understanding of what Rowan called "Canada's premier problem of animal conservation."

A. H. MACPHERSON

Canadian Wildlife Service
Ottawa, Ontario

The Birds

By ROGER TORY PETERSON and the EDITORS of *Life*. Time Inc., New York. 1963. 192 pp. Profusely illustrated (64 pp. in full color). $3.95.

This is the twelfth in *Life's* Nature Library series. In this handsome book lucid writing is combined with drawings and colored photographs to give the reader a clear and up-to-date account of a great many aspects of birds.

Beginning with the origin, evolution, and classification of birds it takes the reader enjoyably through such subjects as bird anatomy and particular avian adaptations (especially for flight) the mechanics of flight, food and feeding adaptations, distribution, numbers, migration, navigation, communication, the breeding cycle, man-bird relationships, and many other subjects too numerous to mention.

One noteworthy feature is an up-to-date breakdown of the numbers of bird species (1) known to occur or to have

occurred, and (2) known to breed, in each of the countries of North America and Europe. For the United States and Canada figures are given for each state and province. This is the first published attempt to bring together these figures on such a wide scope.

The numerous colored photographs are outstanding, sometimes spectacular. They, with many drawings and paintings, illustrate and clarify the text. The latter is extremely readable and authentic. The book contains a useful bibliography and closes with a five-page (four columns each) index. It is an outstanding popular treatment of the ways of birds.

W. EARL GODFREY

Principles in Mammalogy

By DAVID E. DAVIS and FRANK B. GOLLEY. Reinhold Publishing Corporation, New York. 1963. 335 pp. $8.50.

This excellent textbook follows competitively on the heels of Cockrum's "Introduction to mammalogy" recently reviewed by me (Canadian Field-Naturalist, 77:54). However, the two works approach mammalogy with different emphasis. Cockrum leans heavily towards taxonomy while Davis and Golley are oriented towards ecology. The authors say that "The material is selected to provide an idea of how the mammal lives, not only in its environment, but in association with other mammals as well".

Chapter titles include "The Kinds of Animals", "The Nature of Adaptation and Evolution", "Adaptation", "The Evolution of Mammals", "Zoogeography", "Reproductive Processes", "Mammalian Populations", "Metabolism of Populations" and "Activity and Behavior".

I find the book generally well written and authoritative. The references are numerous, although they largely ignore work done outside of the United States of America. The book is attractively bound and well printed, although some graphs and line drawings appear to have been rushed to meet a deadline. There is some lack of evenness between chapters, probably reflecting the division of subjects between the authors. Chapter seven is in some places awkwardly written, for instance (p. 165): "Of some importance in understanding the lives of mammals is a knowledge of the clitorus . . ." and (p. 168) "Whales keep the testes within the abdomen at all times and the penis is held in a sac . . .". The statement that "rodents are entirely spontaneous ovulators . . ." is incorrect. A serious omission is the failure to include A. V. Nalbandov's "Reproductive Physiology" among the references for this chapter.

A keener taxonomic eye would have prevented the inclusion of a nonexistent species of whale in a table on page 90. However, the book is relatively free of typographical errors.

A professional mammalogist will find he has no choice but to own both Davis and Golley's, "Principles in mammalogy" and Cockrum's, "Introduction to mammalogy". The teacher of a course in mammalogy will consider himself fortunate to be in a position to choose from two texts.

PHILLIP M. YOUNGMAN

The Monarch of Mularchy Mountain

By BRUCE S. WRIGHT. Brunswick Press, Fredericton, N.B. 1963. 149 pages, 40 illustrations. $3.95.

This book consists of a collection of five stories concerning familiar Canadian mammals: the white-tailed deer; eastern panther, or mountain lion; black bear; bobcat and moose. The chapters are not disconnected however. The scene is the same in each story—Mularchy Mountain and the Burnt River Valley, N.B., and the main actor of each chapter appears briefly in the previous chapter in a minor role. For each species, birth, death and

the annual cycle of events concerned with the four seasons are described.

The natural homeostatic processes in wildlife populations which tend to maintain an integrated community are stressed. The disruptive forces of human activity are highlighted and the benefits to be reaped by sportsmen and farmers in a balanced biotic community are pointed out. The game warden and the wildlife biologist play important roles in interpreting the wildlife community to the local populace.

The excellent illustrations, gleaned from the files of the U.S. Fish and Wildlife Service, Canadian Wildlife Service, N.B. Travel Bureau and Colorado Fish and Game Department, have been cleverly worked into the text. The style is straightforward, even facile in spots, particularly the description of the stalk of the white-tail buck—the Monarch of Mularchy Mountain.

This book is a useful first reader in animal ecology and wildlife management, set in the Canadian scene, for students from about grades seven to ten.

A. W. F. BANFIELD

National Museum of Canada
Ottawa, Ontario

A Sharing of Joy

By MARTHA REBEN. Harcourt, Brace and World Inc,, New York. 1963. 183 pp. $4.95.

The dust jacket of this volume proudly announces its content as "*The true story of amazing friendships in a mountain wilderness*" (italics mine). If the potential reader is worried that this might indicate a somewhat anthropomorphic approach by Miss Reben, a quick sample of chapter headings – "Goose Ways", "Treetop Tumblers", "Duck People", "Miss Primsy's Last Flight" or names for individual animals—"Goosie", "Philander", "Dumpling" or "Wee Willie Winkie" will serve to assure him that the assumption is entirely warranted. However, despite this, the text is readable, sincere and entertaining and is reasonably free from the exaggerations which usually accompany an approach of this type.

The mountain wilderness is the fast shrinking forest of the Adirondack Mountains of New York State, and the amazing friendships include a variety of animals, both domestic and wild, from goat to bear to wasp, which at various times lived near or with the author.

Miss Reben received her first opportunity to live out-of-doors after spending three years in a sanatorium, bedridden with tuberculosis. Her writing has the genuine enthusiasm of one who suddenly contacts a previously unappreciated portion of life. The personalization of the animals encountered arises from this enthusiasm and from the conviction that each has its own individual qualities.

Her introduction mirrors both her enthusiasm and her approach: "I doubt that one can really know a wild animal unless it has full freedom in natural surroundings. . . . I have tried not only to show the extraordinary diversity of some of the wild friends I have known, but also to capture and thereby share a little of the joy they have given me". Many readers, especially those who have had the satisfying yet often exasperating experience of sharing surroundings either in nature or at home with an animal allowed its freedom, will enjoy this volume.

FRANCIS R. COOK

NOTES

Common Egrets Nesting near Amherstburg, Ontario

After moving to Essex County, Ontario, in 1956, I enjoyed seeing Common Egrets (*Casmerodius albus egretta*) in the marshes along the highways and feeding in some secluded places. By the summer of 1958, I was convinced that they were nesting on the mainland but it was July 1959 before I located a heronry with egret nests on the mainland between Amherstburg and Harrow. A mixed heronry, located on private property, has had egrets nesting in it since 1954.

The first Common Egrets known to nest in Canada were found in 1953 on East Sister Island, Ontario (Langlois, 1953, Audubon Field Notes 7:306). The following year egrets were found nesting on islands in the Detroit River and Lake St. Clair (1955, Jack Pine Warbler 33:8); this is the first record of nests in Michigan. With nests on islands on three sides of the county it was difficult to know where the egrets that came to feed in the marshes were nesting.

About a mile from Lake Erie and surrounded on three sides by marsh is the mixed heronry of about one hundred nests in a hardwood grove composed of elm (*Ulmus americana*), shagbark hickory (*Carya ovata*), and oaks of different species. The nests vary in size but are used by Great Blue Herons (*Ardea herodias*) and Common Egrets only. Black-crowned Night Herons (*Nycticorax nycticorax*) and Green Herons (*Butorides virescens*) have been seen flying around the heronry but do not nest there.

Young Great Horned Owls (*Bubo virginianus*) were often seen in the woods in the spring of 1960 and a nest of Bald Eagles (*Haliaeetus leucocephalus*) was found about half a mile from the heronry.

In five years' observations, the Common Egrets arrive from a week to ten days after the Great Blue Herons to feed in the marshes. Feeding grounds surround the heronry, but because of variations in water levels, the egrets are forced to move from season to season and sometimes, as in 1958, several times within one season.

On July 25, 1959, I first visited the heronry. There were several nests of egrets and when the birds were disturbed, the egrets flew off in groups of fours and fives. The young herons were not as far advanced and few were flying.

A second visit was made on August 4, with Mr. R. D. Ussher, but by this time the birds landed in the trees and not in the nests. As the sun set, the egrets assembled to roost in a row of trees near the heronry and fifty-five were counted.

On April 23, 1960 one week after arrival, a pair of egrets was seen flying in and out of the nest. On May 17, Mr. J. L. Baillie, of the Royal Ontario Museum, visited the heronry and saw two pairs of egrets flying in and out of the nesting area. Eggshells were already on the ground as the young herons were starting to hatch.

The first nest was never actually located because of the thick foliage. The second nest was in a dying elm tree with thirteen other nests, several of which were occupied by Great Blue Herons. This second nest raised one young bird, which was able to fly off after the parents when I visited the heronry on July 23.

There were more dead herons in the heronry this year than last, and, on August 18, a dying young egret was picked up on the Lake Erie shore and sent to the Southern Research Station at Maple.

October 15, (1960), is the latest that I have seen egrets in the Lake Erie area. In the Lake St. Clair marshes, Mr. E. Hueghlin has seen egrets as late as October 30, (1959). The flocks that fly over these marshes and roost in the trees become quite a spectacle in late summer.

Unfortunately the Lake Erie heronry was 25 miles from my home and the nests could only be observed on weekends. I should like to acknowledge the help of Mr. R. D. Ussher, Park Naturalist of Rondeau Provincial Park, in this project.

WINNIFRED SMITH

304 Delhi St.
Guelph, Ontario
4 April 1961

A Breeding Record For The Bobolink in Prince Edward Island

THE BOBOLINK, *Dolichonyx oryzivorus* (L), is relatively common in suitable areas of Nova Scotia (Tufts, 1961, *The Birds of Nova Scotia*), including dykelands and coastal meadows across Northumberland Strait from Prince Edward Island. Despite the narrowness of the strait, nine to about twenty-five miles, the bird has been infrequently observed in P.E.I., most visitors appearing in the area south of Charlottetown.

In mid-July, 1955, the author first heard the Bobolink near Grand River, Prince County, in the western third of the province. On June 10, 1957, a male was seen at Bideford, Prince County, but almost daily visits there failed to elicit further sightings. In 1961 several observations were made at Ellerslie, Prince County: May 25, 1 male; May 26, 2 males; May 27, 6 males; June 1, 1 male, 1 female. On July 7 four males were seen at Bideford. A similar record was obtained in 1962 at Ellerslie: May 19-21, 1 male; May 26, 4 males; June 10, 3 males, 3 females; July 18, 1 male. Nests were not sought in the latter two years but breeding probably occurred.

Beginning May 20, 1963, five males became established in a riverside meadow at Ellerslie. On July 1, a ground nest of soft grass was found containing six fledgelings and one egg. The advanced young left the nest during the observation, and the nest was later abandoned by the family. The parent birds were frequently observed feeding their scattered brood during the ensuing week, and from similar behaviour among other adult Bobolinks the existence of four, possibly five more nests in the meadow was deduced. The first flying young was seen on July 4. Singing and general activity were suppressed from about July 15 to 21, except for one pair tending a late-developing brood. After July 31 no Bobolinks were observed at Ellerslie until August 23, when six were seen among a large flock of mixed blackbirds feeding in harvested grain fields. Singing males were occasionally seen elsewhere in central Prince County during the summer, and several reports which accurately described the bird were received.

Considerable meadowland lays fallow in Prince Edward Island, offering excellent habitat for the Bobolink, and it is surprising that the species has not long since become established. Also, Northumberland Strait would seem to present no great difficulty to this long-range migrant. The question arises then, whether the Bobolink's current extension of its range represents a true and continuing migration path, or a temporary displacement of the Nova Scotian coastal birds arising from population pressure there.

STANLEY E. VASS

Ellerslie, P.E.I.
17 September 1963

A Spadefoot Toad from Manitoba

THE MOST RECENT PUBLISHED RANGE MAP of distribution of the Plains Spadefoot, *Scaphiopus bombifrons*, in Saskatchewan (Cook, 1960, Copeia (4):363-364) shows the eastern limit as the area between North Portal and Roche Percee, southeast of Estevan. Incidentally noted in the text was a single Manitoba locality, Dauphin.

On July 22, 1963, the junior author collected an adult *Scaphiopus bombifrons* on his parents' farm, approximately five miles southwest of the town of Oak Lake,

Manitoba. It was discovered while he was hoeing raspberry plants in the garden, about fifty yards from the house, and appeared suddenly, hopping into the open from under a raspberry bush. It was probably disturbed, perhaps unearthed, by the hoeing. The weather was bright and sunny and the time about 3 p.m. The specimen has the darkly pigmented throat of a male in breeding condition. It has been catalogued as NMC 7379 and measures (after preservation) 55 mm snout-vent length and 18 mm tibia. It has been compared with Saskatchewan material of the species and agrees in colour and proportions.

The Dauphin collection, NMC 1863, Dauphin, Manitoba, July 25, 1935, C. M. Sternberg, has been re-examined. It consists of three immature, probably recently transformed, specimens which measure 28, 24 and 23 mm snout-vent. The senior author had previously doubted the provenance of this collection due to the lack of additional specimens from Manitoba and because the locality lies in a northern extension of the forest and grassland region of Rowe (1959, *Forest Regions of Canada*). All known localities of the spadefoot in Alberta and Saskatchewan lie within the grassland region of these provinces (Cook, unpublished data). Communication with the collector, C. M. Sternberg, has verified that he was in the Dauphin area at the date of collection, although he does not recall the specimen nor the circumstances of capture. The later is of little significance after a lapse of twenty-eight years.

The Oak Lake locality is also within the forest and grassland region. This region is a mixture of prairie and aspen woodland in which the grassland areas apparently supply habitat for *Scaphiopus*. Bird (1961, *Ecology of the Aspen Parkland of Western Canada*) has indicated that the southern border of this region fluctuates, and that since 1900 it has probably extended considerably southward into the formerly pure grassland. It is possible that these collections represent relict populations of spadefoots from a period of more northern extension of the grassland region. However, the species may be wide-spread within grassland areas throughout the grassland and forest region and have evaded discovery due to their nocturnal habits and sporadic (only after heavy rains) breeding. Although the senior author and R. A. Henry spent July and August, 1960, collecting reptiles and amphibians in southwestern and south-central Manitoba, including brief periods in the Daphin and Oak Lake regions, their failure to find *Scaphiopus* must have been due to its secretiveness.

FRANCIS R. COOK
DAVID R. M. HATCH

National Museum of Canada
Ottawa, Ontario, and
Oak Lake, Manitoba
11 October 1963

A Weevil in the Ear of Child at London, Ontario

ON MAY 5, 1963, at 4.00 p.m., a six year old girl at London, Ontario, complained of having "a butterfly in my ear". When her right ear was examined the posterior end of a beetle was seen moving about in the external ear. When removed from the ear the insect was alive and active and proved to be a Sweet Clover Weevil, *Sitona cylindricollis* Fahr., identified by Mr. W. J. Brown, Entomology Research Institute, Department of Agrciulture, Ottawa. The specimen is preserved in the collection of the Department of Zoology, University of Western Ontario. After the weevil had been removed the child reported no further discomfort. It had evidently entered the ear when the child was playing in the grass in a backyard.

Horsfall (1962. *Medical Entomology*. Ronald Press, New York) records that people have experienced pain as a result of small beetles entering an ear and then crawling over the ear drum. Specific cases of such invasion by scarabeid

beetles are reported by Hallock (1936. *Life history and control of the Asiatic garden beetle.* U.S. Department of Agriculture Circular 246) and Metcalfe, Flint and Metcalfe (1951. *Destructive and Useful Insects.* McGraw-Hill, New York). Maddock and Fenn (1958. *Human ear invasions by adult scarabeid beetles.* Journal of Economic Entomology, 51:546-547) record invasions of the ears of 186 people at a scout jamboree in Pennsylvania. The scarabeid beetles *Cyclocephala borealis* and *Autoserica castanea* were involved in these cases and caused pain because the tibial spines of the beetles pierced the skin of the ear canal.

WILLIAM W. JUDD

Department of Zoology
University of Western Ontario
London, Ontario
12 September 1963

Mass Mortality of Gulls at Rondeau Park, Lake Erie

ON AUGUST 22, 1963, the writers found a large number of dead and dying gulls along a beach at Rondeau Provincial Park, Ontario. This section of beach runs west from the south end of Rondeau Park Road; it is composed mainly of sand, and is some 1.25 miles in length.

Along this beach, eighty dead and four dying gulls were found. In addition, several swam a few yards offshore and refused to flush. Unlike most dead gulls found along beaches, most of these birds appeared intact and quite fresh. Four Ring-billed Gulls, *Larus delawarensis*, two adults and two immatures, crouched low with their eyes open, and allowed themselves to be picked up without struggling. The dead consisted of sixty-two Ring-billed Gulls, fourteen Herring Gulls, *Larus argentatus*, and four Bonaparte's Gulls, *Larus philadelphia.* One dead immature Ring-billed Gull carried band No. 585-77425. No dead terns were noted although both Common Tern, *Sterna hirundo*, and Caspian Tern, *Hydroprogne caspia*, were abundant in the area.

No signs of "oiling" were found on the plumage of any of the birds. It is conceivable that the mass mortality may have been due to local water pollution.

DOUGLAS D. DOW
M. ANNE DOW

Department of Zoology
University of British Columbia
Vancouver 8, Canada
15 October 1963

Three New Bird Records for Prince Edward Island

IN W. EARL GODFREY'S *Birds of Prince Edward Island* (1954, National Museum of Canada Bulletin 132) Mr. Godfrey states, "It is hoped that the present report will stimulate ornithological observation on the island and that observers will publish such additional information as comes to their attention". My bird-watching activities there each summer enable me to report the following three new species for this Province.

Little Blue Heron *Florida caerulea.* On August 20, 1958, I learned that a large white bird had been shot by Wilfred Saunders near one of the fish hatchery breeding ponds at Tyne Valley, fifteen miles northwest of Summerside. It had been passed to a local storekeeper for safekeeping in his freezer on August 10, 1958. I obtained it from him and sent it by air express to the National Museum of Canada, Ottawa, and received word back that it was the first record of the Little Blue Heron for Prince Edward Island and that the specimen had been prepared for the research collection of the Museum.

Willet *Catoptrophorus semipalmatus.* Eric Holdway recorded the first Willets observed in Prince Edward Island. Master of the ferry *Lord Selkirk* which runs between Caribou, Nova Scotia, and Wood Islands, Prince Edward Island,

Captain Holdway takes advantage of the opportunity to keep complete records of birds seen during the fourteen mile crossings. On July 4, 1958, hearing birds calling, he observed three feeding on the mud flats 150 feet from his ship, docked at Wood Islands. Identifying them as Willets, he gave two quick blasts of the ship's whistle, startling them so that he was able to see plainly the flashy wing-pattern. On August 10, 1958, I saw two Willets at Covehead and one August 29, 1963, at Rustico Island, both areas being in the National Park of the Province. Since the breeding range of this species is extending, observers should be on the lookout for evidence of breeding in Prince Edward Island.

Stilt Sandpiper *Micropalama himantopus*. Near one end of the bridge at Covehead there is a sizeable brackish pond between the road and the ocean beach. On August 30, 1963, as I drove by, I noted a Greater Yellowlegs and then a much smaller bird wading up to its belly and although I did not at once see its legs it did not look like a Lesser Yellowlegs but appeared to be something different. Flushing it first from one side of the pond and then from the other I knew I was looking at my first Stilt Sandpiper, a bird very uncommon on the Atlantic Coast. At one time when the Greater Yellowlegs and the Stilt Sandpiper were feeding together the difference in their bills was plainly noticeable, the latter bird's bill showing a tapering and droop at the tip. Later, when I was watching from my car, it emerged from the water fifty feet away and I was able to see its greenish legs in a good light. After a thorough preening it took off in a westerly direction and finally disappeared from view. An examination of a study skin of this species in Fall plumage in the Nova Scotia Museum of Science further confirmed my identification.

WILLETT J. MILLS

5486 Spring Garden Road
Halifax, Nova Scotia
31 October 1963

An Eastern Spiny Soft-shelled Turtle from Quebec Province

A HATCHING FEMALE Eastern Spiny Soft-Shelled Turtle, *Trionyx spinifer spinifer*, was captured (by J. L.) at Ile Perrot, Quebec, in late August 1962. Ile Perrot is at the junction of the Ottawa and St. Lawrence rivers.

The site of the capture is a small bay downstream from Brussy Point, one-half mile downstream from the bridges connecting the towns of Ile Perrot and Ste.-Anne-de-Bellevue, at approximately 73° 57′ W., 45° 22.8′ N. (All names and measurements from the "St. Lawrence-Lake St. Louise" chart published by the Hydrographic and Map Service, Ottawa, 1939).

The turtle was found about fifteen feet from shore while crawling across a small mudbank which was about two feet wide and surrounded by water on all sides. The bay is very shallow—one to two feet deep—with a fine sand and mud bottom and with dense subaquatic vegetation. The shore is boulders and sand, reed fringed, and backed with low shrubs growing in swampy ground which is flooded in spring. The head of a second turtle of the same species was seen at the same time. This second turtle was obviously an adult since the head and neck exposed above water was estimated to be about two inches long.

There are no known collected specimens of this turtle from Quebec Province. Logier and Toner (1961. *Checklist of amphibians and reptiles of Canada and Alaska*, The Royal Ontario Museum) list it for Iberville, Quebec, on the Richelieu River. According to Mélançon (1950. *Inconnu et méconnu*. La Société Zoologique de Québec) it is occasionally captured in the Richelieu River. Clarke (1908. The Ottawa Naturalist. 22:7-14) reports it from L'Ange Gardien, and Alexandre (1937. *Les Tortues du Québec*, Bibliothèque des Jeunes Naturalistes, Société Canadienne d'Histoire Naturelle, Tract No. 39) from Lake Champlain and

the Richelieu River. We also have a sight record with a photograph from the Pike River where it enters Mississquoi Bay of Lake Champlain at approximately 73° 06′ W., 45° 04′ N. (P.C.: Hon. Mr. Justice G. M. Montgomery).

The turtle is still alive and in captivity. The carapace was estimated to be about 30 mm long at the time of capture; at the time of writing (October 1963) it has grown to 97 mm. During this time it has been fed on earthworms and pieces of raw fish and raw meat.

It will eventually be deposited in the National Museum of Canada, Ottawa.

JOSEPH LOVRITY
NORRIS DENMAN

34 Sixth Avenue
Ile Perrot, Quebec, and
350 William Birks St.
St. Bruno, Quebec
2 October 1963

Breeding Record for the Bufflehead West of the Coast Range in British Columbia

THE FOLLOWING NOTE REVIEWS the nesting records for the Bufflehead *Bucephala albeola* (L.) west of the coast range summit in Canada, and presents the first record of Bufflehead breeding on Vancouver Island, British Columbia. Brooks (1917, Auk 34:34) reported a female Bufflehead and three young on Sumas Lake, B.C., and Taverner (1919, Condor 21:80-86) reported a brood seen by Spreadborough near Hazelton, B.C. These appear to represent the only recorded nesting records for the Bufflehead west of the coast range summit. Anthony Erskine (*pers. comm.*) of the Canadian Wildlife Service considers these two records as accidentals (here meaning a breeding record in an area outside the defined and accepted breeding range of the species).

The following is a summary of information I collected on two small ponds two miles north of Middle Quinsam Lake (lat. 49° 55′, long. 125° 29′) Vancouver Island. The data are supplemented by notes supplied through correspondence with William Munro, of the Canadian Wildlife Service, and James Bendell and Peter Elliott, of the University of British Columbia.

1960. Pond Number 1.

May 29–female with four downy young about 8-10 days old ("1 b" stage, 1954, Gallop and Marshall, Mississippi Flyway Council and Technical Council. A guide for aging duck broods in the field) and a female with eight 4-6 days old ("1 a" stage) downy young. Two males and a broodless female were also present.

June 19–two adult females but no young.

1961. Pond Number 1.

June 7–Elliott observed female bufflehead leaving nesting hole.

June 9–female with nine downy young (Elliott).

1961. Pond Number 2.

June, between the 13th and the 20th–female and two downy young seen by Munro.

1962. Pond Number 1.

No date–female and brood seen several times (Elliott).

For a number of summers prior to 1960, Buffleheads were reported in this area though no positive evidence of breeding was detected (Bendell *pers. comm.*).

These records clearly establish the Bufflehead as a breeding bird of the Quinsam area for the years 1960 through 1962.

It is interesting to speculate on some of the reasons responsible for this recent invasion. A comparison of the structure of the vegetation in the Quinsam burn area, with that of established bufflehead breeding range, for example the Cariboo district, suggests much similarity. The following is a description of the vegetational structure of the Quinsam area. Thirty-two thousand acres of logged and mature timber were burned in 1951. The present successional stage has much bare ground, charred stumps, recently planted

conifer seedlings, and open to dense thickets of willow (*Salix* spp.) and alder (*Alnus oregona*). Salal (*Gaultheria shallon*), bracken (*Pteridium aquilium*), blackberry (*Rubus macropetalus*), and hare's ear (*Hypochaeris radicata*) are the shrubs and herbs in greatest abundance. The ponds are ringed by dead and living mature conifers which escaped both axe and fire. The first pond, about four acres in size, is mud bottomed and bordered by a floating sphagnum mat. A few feet from the water's edge this mat supports a thick layer of sweet gale (*Myrica gale*) and labrador tea (*Ledum groenlandicum*). On the east and west sides of the pond this gives way to the soils of the original pond edge which supports salal and a narrow ring of tall conifers, Douglas fir (*Pseudotsuga menziesii*), western red cedar (*Thuja plicata*), and western hemlock (*Tsuga heterophylla*). Beyond the edge of the pond is the open burn. At the north and south ends of the pond are thickets of willow and hardhack (*Spiraea douglasii*). The second pond, about five and a half acres in size, lacks the sphagnum mat and the living conifers, but has an extensive stand of dead conifers, primarily cedars, surrounding it. Much windfall makes the shoreline impenetrable. The elevation of the ponds is approximately 900 feet.

It is likely that extensively logged and/or burned areas offer a habitat whose structure fulfills the nesting requirements of the Bufflehead. Fires had occurred in the area of Taverner's and Brook's Bufflehead records. However, British Columbia Forest Service records of these areas are incomplete for these early dates, and it is, therefore, impossible to either fully substantiate or dispute the view that similar conditions prevailed in these areas at the time of their records.

If, as suggested, the physiognomy of large logged and burned areas meets the breeding requirements of the Bufflehead, it is difficult to account for the lack of previous coastal nesting records in these areas. These new breeding records may represent "accidentals", but it appears more likely to me that they are the result of recent invasion into a newly created breeding range. I suggest such a population of birds be regarded as transient. Population densities will rise and then fall both spatially and temporally as the habitat progresses from an open logged or burned area to a forest. The few records available are, I suggest, primarily the result of the lack of data from these regions. No final decision can be reached, however, without further investigation.

I am grateful to the above contributors for the use of their notes. Acknowledgment and thanks are here given to Dr. J. F. Bendell, and to Dr. E. M. Hagmeier of Victoria University, for their advice and criticism in the preparation of this note.

DAVID A. HANCOCK

Department of Zoology
University of British Columbia
6 November 1963

A Northern Range Extension for *Bufo americanus* with Notes on *B. americanus* and *Rana sylvatica*

DURING JULY, 1963, a National Museum of Canada field party collected along the coast of James and Hudson Bays from Moosonee, Ontario, to the Port Harrison Gulf area, Quebec. The expedition consisted of A. H. Clarke, Jr., and D. E. McAllister, leaders, and H. D. Athearn.

Only two species of herptiles were seen during the course of collecting which was concentrated on fresh and salt water mollusks and fish. Due to the paucity of records from the area all herptile specimens are reported here. Numbers prefixed NMC are National Museum of Canada catalogue numbers.

Bufo americanus: QUEBEC: NMC 7383, Eastmain, July 5 (1 specimen); NMC 7385, at RCAF Station, Great Whale River, July 8 (1); NMC 7387, 2-3 miles up from mouth of Deer River, Rich-

mond Gulf, July 19 (1); ONTARIO: NMC 7389, Creek tributary to Moose River, Moosonee, July 26 (1).

The Deer River specimen (56° 17'N., 76° 10' W.) represents an approximately 85 mile range extension from the previously known northern limit of this species at Great Whale River (Logier and Toner, 1961, *Checklist of the Amphibians and Reptiles of Canada and Alaska*).

The Moosonee specimen shows the greatest resemblance to the disputed race *B. a. copei* in having a strongly contrasted pattern, wide mid-dorsal stripe, heavily spotted and reticulated venter, and long, narrow parotoid glands. The other specimens show a south to north cline from the Moosonee to the Deer River specimen which is more-or-less typically *B. a. americanus* with only partial ventral spotting.

The habitat for the Deer River specimen was a grassy area bordered by a low muddy river bank on one side and clumps of willow, reaching a height of four to five feet, on the other. Richmond Gulf is at the northern limit of the tree line on the east coast of Hudson Bay. Spruce grew on the opposite bank of the river but not on the side where the collection was made.

Specimens were 63, 70, 69 and 65 mm respectively. The Deer River toad is a male, probably in breeding condition, with a dark throat vocal sac.

Two collections of toad tadpoles were made. NMC 7393, Fort George River, 17 mi. E. of Fort George, Quebec, July 17, was taken in rock pools at the edge of rapids. The nineteen specimens were staged as follows: 29 (1), 32 (1), 33 (5), 35 (5), 36 (2). NMC 7610, stream, N. central Burton Lake (S. of Great Whale River), Quebec, July 24. Three tadpoles staged at 35 (1), 43 (2). The stages follow Gosner (1960, Herpetologica 16 (3): 183-190).

Rana sylvatica: QUEBEC: NMC 7382, Eastmain River, 1 mi. E. of Eastmain, July 3 (2); NMC 7384, Bank of Fort George River, 8 mi. E. of Fort George, July 3 (2); NMC 7386, Deer River 2-3 miles up from mouth, Richmond Gulf, July 19 (6); ONTARIO: NMC 7388, Creek tributary to Moose River, July 26 (1).

The Deer River specimens are immatures, 28 to 25 mm snout-vent length, and all lack a dorsal line. Specimens from the other localities are 40-49 mm and all have a dorsal line. Logier and Toner (1961) give George River as the northern locality on this coast. Bleakney (1954, Canadian Field-Naturalist 68(4):165-171) cites a collection from Richmond Gulf.

One collection of tadpoles was made, NMC 7609, N. central Burton Lake, Quebec, July 24. Two tadpoles were staged as above at 31 (1) and 32 (1).

Bleakney (1958, National Museum of Canada, Bulletin 155, table 3, p. 67; map 5, p. 74) delineated herpetofauna zones in eastern Canada. Zone 6 contains *Bufo americanus*, *Rana sylvatica* and *Rana septentrionalis*; zone 7 contains only the latter two species. At the east coast of Hudson Bay the northern limit of zone 6, which is based on the northern limit of *Bufo americanus*, must now be moved from Great Whale River to Richmond Gulf, making it synonymous with the northern limit of zone 7 at this point. Future collecting will establish if *Bufo americanus* ranges as far north as *Rana sylvatica* at all points, thus eliminating zone 7, or if the Richmond Gulf situation is caused by some factor such as a warming effect at the coast while the inland areas remain validly differentiated into two zones.

No frogs were observed at Port Harrison, north of Richmond Gulf, nor on any the coastal islands visited between Great Whale River and Port Harrison.

I am indebted to the collectors for the specimens, their field notes, and their permission and encouragement to report on these specimens.

FRANCIS R. COOK

National Museum of Canada
Ottawa, Ontario
8 October 1963

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WINTER MORTALITY AMONG RED-NECKED GREBES (*Colymbus grisegena*) IN ONTARIO

ANTOON DE VOS AND ALBERT E. ALLIN,
Department of Zoology, Federated Colleges, Guelph, Ontario
and Regional Laboratory, Ontario Department of Health, Fort William, Ontario

DURING LATE FEBRUARY and early March 1963, many reports came into the offices of the Ontario Department of Lands and Forests and the Ontario Humane Society stating that Red-necked Grebes, *Colymbus grisegena*, had been found stranded, either dead or alive, in unlikely places on land. Because it was suspected that further information could be obtained, an inquiry was launched, the results of which will be discussed.

The Red-necked Grebe was considered a bird of the Prairies, but during recent decades it has shown a tendency to extend its summer range into the Great Lakes area. It has been found nesting near Burlington at the western end of Lake Ontario since 1943 (Speirs *et al.*, 1944), and in the Cochrane District in northern Ontario since 1955 (Snyder, 1957).

This species has been found wintering on Lake Ontario near Toronto, near Niagara Falls, on Lake Erie near Ashtabula, Ohio, and on Lake Michigan (Bent, 1919). Snyder (1929) reported that a specimen was sent in to the Royal Ontario Museum on January 16, 1929, which was picked up from a local marsh near Kingston, Ontario. In another paper (Snyder, 1930) he reported that on December 12, 1929, during a heavy sleet storm many grebes had landed on Toronto streets. By mid-afternoon of the thirteenth, twenty-seven live birds had been picked up. By December 15 a total of thirty-seven had been reported for Toronto. One other specimen was reported to have been captured at Brantford, Ontario. Not all birds passing through the Toronto area were stranded, as indicated by several individuals observed along the waterfront on December 14.

Forbush (1925) stated that the species is seldom seen in the interior of southern New England, except when severe cold waves freeze up the Great Lakes or other large lakes westward in which, in ordinary seasons, many of the birds pass the winter. According to him, in trying to escape to open water, many grebes become fatigued and fall or alight on the snow or ice in New England, eastern New York and New Jersey.

Todd (1940) states on pages 35 and 36 "in the winter it prefers the sea coast but sometimes remains on the Great Lakes"'. He adds, "there are February records for this grebe from Erie, Warren, Clinton, Armstrong and Washington Counties. If not pertaining to birds that were actually wintering where they were found, these records must indicate a considerable wandering

Mailing date of this number: 28 August, 1964

at certain times from a presumed winter habitat elsewhere, probably Lake Erie. This explanation is suggested by the fact that Mr. Simpson has on several occasions found this grebe at Warren early in February during blizzards. Some were picked up in an exhausted condition, due apparently to lack of food."

Janet C. Green obtained several reports of Red-necked Grebes wintering at the extreme western end of Lake Superior near Duluth, Minnesota:

1 bird on Nov. 1, 1961 (The Flicker, 33(4): 114, 1961)
1 bird on Feb. 19, 1962 (The Flicker, 34(1): 22, 1962)
1 bird on Dec. 6, 1962 (The Flicker, 34(4): 114, 1962)
1 bird on Jan. 5, 1963 (The Flicker, 35(1): 15, 1963)
1 bird on Jan. 15, 1963 (The Flicker, 35(1): 15, 1963)

S. D. Robbins (*in* letter dated March 14, 1963) stated that there are no winter records for Wisconsin, but that little winter work has been done along the Lake Superior shore of Wisconsin. His latest date for the state is November 16, 1951 at Milwaukee. Probably the specimen seen on March 5, 1962 at Madison (Audubon Field Notes 16(3): 331, 1962) was a very early arrival. W. Nickell (*in* letter dated March 7, 1963) reported that there were no winter records for Lake Michigan.

Records about observations of grebes in Ontario during the winter were obtained from the Ontario Department of Lands and Forests (courtesy Mr. R. E. Mason), the Ontario Humane Society (courtesy Mr. T. I. Hughes), and The Ontario Naturalist (1(2): 33, 1963 (Table 1). In addition to data contained in Table 1, "numbers" were found in snow drifts in the Paisley-Wingham area (Ontario Naturalist, 1963).

An analysis of data covering winter 1962-63 suggests that the largest number of grebes was displaced during the second half of the month of February. It also suggests that the majority of these displaced birds were found in a relatively restricted section of the peninsula of southern Ontario, namely Bruce, Grey, Simcoe, Huron and Wellington Counties. It should be stated here that personnel of the Ontario Department of Lands and Forests could not obtain any records in reply to our questionnaire from area west and east of those referred to in Table 1. As will be noticed, the majority of the grebes were alive when found. The bird found in early March on the shore of Inverhuron Park was perhaps netted. Most grebes were found on roads or road shoulders. Perhaps roads bare of snow have a special attraction for displaced grebes.

What may cause large numbers of grebes to become stranded on land during the winter? The most obvious answer that comes to mind is certain weather conditions.

The winter of 1962-63 was unusually severe, which resulted in all of the Great Lakes, except Lake Ontario, becoming completely covered with ice or nearly so. Data supplied by the Meteorological Branch, Department of Transport, Canada, indicated that on February 15 Lake Erie had only relatively small stretches of open water, while only very little open water could be found at the south ends of Lakes Huron and St. Clair. On Lake Superior there was almost no open water on February 12. These records were taken

Table 1. — Records obtained of stranded Red-necked Grebes

Date	Location	No.	Dead	Alive	Source
Dec. 13, 62	Blanchard Twp.	1	X		L & F
Jan. 6, 63	Cobourg	1		X	O.N.
Feb. 6, 63	W. Luther Twp., Wellington Co.	1		X	L & F
Feb. 14, 63	Fort William	1	X		A. E. Allin
Feb. 16, 63	Harriston	1		X	L & F
Feb. 20, 63	Howick Twp., Huron Co.	1		X	L & F
Feb. 20, 63	Guelph	1		X	O.H.S.
Feb. 21, 63	Barrie	3		X	O.H.S.
Feb. 22, 63	Southampton				L & F
Feb. 23, 63	Kincardine Twp., Bruce Co.	1		X	L & F
Feb. 23, 63	Huntsville	1		X	O.N.
Feb. 26, 63	Allendale	1		X	O.H.S.
Feb. 28, 63	Collingwood	1		X	O.H.S.
Feb. 28, 63	Stroud	1		X	O.H.S.
Feb. , 63	Glengarry Co., 14 mi. N of St. Lawrence	1	X		O.H.S.
Feb. , 63	Blanchard Twp.	1	X		L & F
Feb. , 63	Downie Twp.	1	X		L & F
Feb. , 63	Ellice Twp.	1	X		L & F
Mar. 2, 63	Port Elgin	1		X	L & F
Mar. 5, 63	Rostock, Ellice Twp.	1	X		L & F
Mar. (early)	On shore of Inverhuron Park	1	X		L & F
Mar. 18, 63	Guelph	1		X	O.H.S.
Mar. 23, 63	Huron Twp., Bruce Co.	3		X	L & F

Note: February 17-23: Twelve telephone calls were investigated by Conservation Officer G. R. Harris about grebes along sides of roads in Bruce County. Several grebes were also found in the Wingham area. Six more calls were investigated since then.

No reports were received from the Clinton, Meaford, Lions Head and Paris area.

L & F = Ontario Department of Lands & Forests records
O.H.S. = Ontario Humane Society records
O.N. = The Ontario Naturalist (1), 1963.

during the period when most casualties were observed among the grebes. Nevertheless, there was some open water. Would it be plausible that the grebes were displaced by drifting ice or were moving from one lake to the next and unable to find open water? The problem is not adequately solved by this report, but further documentation might clarify the situation.

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A LIST OF VASCULAR PLANTS FROM AROUND OGAC LAKE, SOUTH COAST OF FROBISHER BAY, N.W.T.

IAN A. MCLAREN

Fisheries Research Board of Canada, Arctic Unit, 505 Pine Ave. W., Montreal 18, Que.*

THE PLANTS LISTED HERE were collected by several people during three seasons at Ogac Lake at 62° 52′ N and 67° 21′ W on the south side of Frobisher Bay. In each season plants were collected incidentally to the main program, which was the study of the hydrography and biology of the lake, which is in fact the almost landlocked head of a fiord, with a depauperate marine biota, including a relict population of the Atlantic Cod *Gadus morhua* L. The general nature and interest of the lake have been discussed briefly by Dunbar (1958, p. 198-199).

In 1952 R. S. McCall and A. D. Dawson, under the auspices of the Arctic Institute of North America, made a preliminary survey of the lake between July 16 and August 22, and collected sixty-three species of vascular plants. In 1957 I stayed at the lake between June 1 and October 4, and my wife Bernice, who was my sole companion and assistant, made a collection of seventy species, including nine not taken in 1952. In 1962 I made further detailed studies at the lake between June 1 and August 28. Armed with Porsild's (1957) manual, my assistant Mr. T. E. Welch (who paid special attention to the grasses and sedges) and I were able to increase the list of local plants to 124 species.

The area around the lake consists of metamorphic and igneous Precambrian rock. The coast of Frobisher Bay here is rugged and indented with a series of steep-sided inlets; Ogac Lake is at the head of one such inlet, Ney Harbour. There is very little level ground around the lake, and since the lake is L-shaped, its steep sides face in almost every direction. There are cold, barren faces receiving very little sunlight during the day, and other slopes which are warm, sheltered and lush with flowers. In general, the local climate is rather more salubrious than that found even five miles away, on the coast of Frobisher Bay. The high, steep hills, up to 2000 feet, inhibit winds from most directions and trap heat. The snowfall along the south coast of Frobisher Bay is unusually high, enough to sustain the most southerly glaciers in the Archipelago, about forty miles southeast of Ogac Lake (*see* Mercer, 1956).

Most previous collections from southeast Baffin Island are listed by Polunin (1940). Since that time, the only major published collections from the region appear to be those of Calder (1951), who lists 149 species from the head of Frobisher Bay, which is topographically, climatically, and botanically rather different from the Ogac Lake region. The recently described flora of the vicinity of Merewether Crater, Northern Labrador (Gillett, 1960), is in many ways more comparable with that from Ogac Lake.

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*Present address: Marine Sciences Centre, McGill University, Montreal, Quebec.

Of especial interest in southeast Baffin Island is the presence of amphi-Atlantic and subarctic elements, otherwise found in Greenland and Labrador-Ungava and points east or west. The three additions to the flora of the Canadian Arctic Archipelago given in this paper (*Carex anguillata*, *Luzula multiflora* ssp. *frigida* var. *contracta*, and *Viscaria alpina*) are all of this distribution, and a few other species of comparable range have previously been collected only once or twice from the Archipelago. A number of plants are found in the Greenland flora which have not hitherto been recorded in North America proper. It may be that the unnamed species of *Erigeron* discussed in this paper will prove to be one of these. The southeast corner of Baffin Island may be important in understanding a number of phytogeographic problems, and deserves more collecting activity.

I wish to thank Messrs. A. D. Dawson, R. S. McCall, and T. E. Welch, and my wife Bernice, who did much of the collecting. Dr. Paul Maycock, Department of Botany, McGill University, gave me free access to the Herbarium, and helped in other ways. Dr. Askell Löve, Montreal Botanical Garden, offered an opinion on the identity of the unnamed species of *Erigeron*. Dr. A. E. Porsild, National Herbarium, examined and revised all the critical material in the collections — the grasses, sedges, *Luzula* spp., willows, *Draba* spp., and *Antennaria* spp. — and also read critically this manuscript. I am most grateful for his help.

Annotated List of Species

In the following list, the nomenclature of Porsild (1957) is used throughout. Specimens of all species listed are in the McGill University Herbarium, Montreal. Some of the more unusual material has been deposited in the National Herbarium, Ottawa, as well. The listed specimen numbers consist in each case of the year of collection (1952, 1957, or 1962) followed by the collecters' field numbers.

Woodsia ilvensis (L.) R. Br.: Common on crumbling cliffs near the lake outlet. 1962-27, 103.

Woodsia glabella R. Br.: One collection from rock clefts. 1962-26.

Cystopteris fragilis (L.) Bernh.: The commonest fern. 1962-29, 30, 106. Large specimens (1962-106) up to 35 cm were collected from among dense shrubs of *Salix cordifolia* on the south-facing slope of the inner lake basin.

Equisetum arvense L.: Common. Densest stand of plants noted on rather sterile sand at the bottom of a deep gorge one mile west of the lake (1962-104), but also occurred on sunny, grassy slopes (1962-105).

Equisetum variegatum Schleich.: Not common, or overlooked. 1962-51.

Lycopodium annotinum L.: Common only among willows and on herbmats on the south-facing slope of the inner basin of the lake. 1962-109, 110.

Lycopodium Selago L.: Common on heathy areas. 1962-108.

Hierochloë alpina (Sw.) R. & S.: The related, recently described *H. orthantha* Sør. did not occur in the four collections, although it might be expected in the region. 1952-74; 1957-7; 1962-95, 99.

Agrostis borealis Hartm.: Common. 1952-70; 1962-98.

Trisetum spicatum (L.) Richt.: Common. 1962-96, 97.

Poa alpigena (Fr.) Lindm.: Collected only by the 1952 expedition from damp, rich soil near the lake. 1952-68.

Poa arctica R. Br.: Abundant. 1952-72, 82; 1962-120, 121.

Poa alpina L.: Scattered clumps everywhere around the lake, but nowhere very common. 1962-118, 122, 123.

Poa glauca M. Vahl.: A few specimens collected. 1957-4; 1962-119.

Festuca brachyphylla Schultes: Probably the commonest grass around the lake. 1962-92, 93, 94.

Eriophorum angustifolium Honck.: The commonest cotton grass; found around the numerous ponds near the lake. 1962-83,87.

Eriophorum Scheuchzeri Hoppe: A few unexpanded specimens were taken near a stream one mile west of camp on August 24 (1962-88). A single expanded specimen was taken in 1957 (1957-1).

Eriophorum callitrix Cham.: This attractive species grew in some numbers on black humic soil near *Pinguicula vulgaris* (see below), and a few specimens were taken on a like site near the outlet of the lake. 1962-85, 86.

Eriophorum vaginatum L. ssp. *spissum* (Fern.) Hult.: Collected only twice. 1952-80; 1962-84.

Scirpus caespitosus L. ssp. *austriacus* (Pallas) Asch. & Graebn.: Common. 1962-53, 76.

Carex nardina Fr. var. *atriceps* Kük.: On gravel beach of lake and on south-facing, grassy slope. 1962-65, 68.

Carex scirpoidea Michx.: Common. 1962-54, 62, 70.

Carex rupestris All.: Only a single specimen collected. 1962-69.

Carex Lachenalii Schk.: One collection from near stream emptying into inner basin of the lake, 1962-61.

Carex glareosa Wahlenb. var. *amphigena* Fern.: Collected only by the 1952 expedition, which found it common near the shores of a small pond, less than one metre above the level of Ogac Lake.

Carex Bigelowii Torr.: The commonest sedge in a variety of habitats, and often the commonest plant. 1952-67; 1962-62, 64, 73. Specimens of *C. anguillata* [*f. anguillata* (Drej.) Fern.] were collected from dry, sandy soil between streamlets, and identified from among the material by Dr. Porsild (1962-60). This appears to be the first record of this form from the Archipelago.

Carex norvegica Retz.: Only a single small specimen taken in 1962, although noted as being common near the outlet of the lake in 1952. 1952-68; 1962-93.

Carex holostoma Drej.: Collections from black humic soil near *Pinguicula vulgaris* and *Eriophorum callitrix* and on a similar site near outlet of lake. 1962-52, 66.

Carex supina Wahlenb. ssp. *spaniocarpa* (Steud.) Hult.: On the upper parts of a sandy-gravel beach on the east side of the lake. 1962-62.

Carex glacialis Mack.: Collected only by the 1952 expedition, atop Knife Edge Mountain (ca. 600 m). 1952-97.

Carex misandra R. Br.: This high-arctic species was collected only from two slopes, both south-facing in 1962. 1952-75; 1962-55, 71.

Carex capillaris L.: A single, over-ripe specimen taken from wet ground on the south-facing side of the inner lake basin on August 18. 1962-72.

Carex membranacea Hook.: Locally common 1952-84; 1957-3; 1962-56, 67.

Juncus biglumis L.: Apparently scarce. 1952-91; 1962-89.

Juncus trifidus L.: Not common, but conspicuous on dry sunny slopes, and also at the bottom of a deep gorge, one mile west of the lake. 1962-74, 75, 90.

Luzula nivalis (Laest.) Beurl.: Taken only once, on rather damp tundra. 1962-79.

Luzula spicata (L.) DC.: 1962-80, 81, 92.

Luzula confusa Lindebl.: Everywhere common. 1952-75; 1962-57, 58, 78, 91, 92.

Luzula multiflora (Retz.) Lej. ssp. *frigida* (Buch.) Krecz. var. *contracta* Sam.: This is the first collection from the Archipelago,

where it was anticipated by Porsild (1957), in view of its occurrence in Ungava and Greenland. At Ogac Lake specimens were taken from the lush, south-facing slope of the inner basin. 1962-82.

Tofieldia pusilla (Michx.) Pers.: 1952-34; 1957-31; 1962-77.

Salix herbacea L.: 1952-12, 86; 1957-13.

Salix Uva-Ursi Pursh: 1957-8; 1962-101.

Salix reticulata L.: 1952-33, 61; 1962-100.

Salix cordifolia Pursh var. *callicarpaea* (Trautv.) Fern.: 1952-94; 1962-115, 117. Formed low thickets about 0.5 m high on parts of the south-facing slope of the inner lake basin (1962-115).

Salix arctophila Cockerell: The most common willow on the low ground around the lake (1952-19, 62; 1957-12; 1962-116), although two collections come from dry hillsides (1952-95; 1962-116).

Salix arctica Pall.: A few flowering specimens in 1957 were the only ones taken, although doubtless overlooked in 1962. 1957-9.

Oxyria digyna (L.) Hill: Abundant. Very lush growth in alluvial gravel at the head of the lake. 1952-71, 78.

Polygonum viviparum L.: 1952-58, 59; 1957-35.

Stellaria longipes Goldie s. lat.: Specimens of the race *monantha* were common on dry areas around the lake outlet, but good *ciliatosepala* were collected from an old tent ring. 1952-37; 1957-39; 1962-44, 45.

Stellaria humifusa Rottb.: Common on more sterile beach gravel and sand near outlet of lake. 1962-43.

Cerastium alpinum L.: Ubiquitous. 1952-41, 64.

Cerastium cerastoides (L.) Britt.: Specimens taken in 1952 were the first Archipelago record (identified by Porsild and mapped in his manual, 1957). In 1962 it was found to be moderately common near the lake edge on more humic, consolidated shores, and was also noted on several wet, mossy sites up to 150 m above sea-level. It was not in flower until early-through mid-August, long after *Cerastium alpinum*. 1952-13; 1962-41, 42.

Sagina intermedia Fenzl.: Uncommon. Found only in damp crevices near the outlet. 1962-25.

Arenaria peploides L. var. *diffusa* Hornem.: Common on gravel shores of lake near outlet. 1957-44.

Arenaria rubella R. Br.: Uncommon. 1962-23, 24.

Arenaria sajanensis Willd.: Common in a variety of settings, especially on rather dry grassy slopes and herbmats. 1962-19, 20, 21, 22.

Silene acaulis L. var. *excapa* (All.) DC.: Common. 1952-22.

Melandrium apetalum (L.) Fenzl. ssp. *arcticum* (Fr.) Hult.: Curiously rare, although looked for. Collected only once in a damp herbmat on an east-facing slope about 300 m above the lake. 1962-35.

Melandrium affine (J. Vahl) Hartm.: Common. 1952-44; 1957-16.

Viscaria alpina (L.) G. Don.: The beautiful alpine campion has not hitherto been recorded in the Archipelago, although anticipated in Porsild's (1957) manual. Two patches of several plants each were found on August 15-18, 1962, along steep, unstable slopes below weathering cliffs on the east side of the lake. The flowers were past prime when discovered. 1962-35. I also collected this plant on August 5, 1951, near the Grinnell Glacier, about 40 miles down the southwest shore from Ogac Lake. These specimens were given to a private collection (Now in McGill Herbarium), and remained unrecorded in the literature.

Ranunculus nivalis L.: This was the common buttercup at Ogac Lake. 1952-30, 77. I looked carefully for *R. sulphureus* Sol., which apparently does not occur.

Ranunculus pygmaeus Wahlenb.: Locally common. 1952-16; 1957-36.

Ranunculus Allenii Robins.: This rather rare endemic of subarctic eastern North America has apparently been taken only once before from the Archipelago, again

from the Frobisher Bay region (*see* Benson, 1948). It was taken only in two places at Ogac Lake in 1962. A few plants were found growing around the springy base of a huge boulder on the south-facing slope of the inner basin on August 20 (1962-36), and three plants were picked from wet moss on one of the few extensive horizontal "meadows", at around 150 m on the west side of the lake, two days later (1962-37).

Papaver radicatum Rottb.: 1952-40; 1957-24.

Cochlearia officinalis L.: The prostrate form, ssp. *groenlandica* (L.) Porsild, was common on the shores of Ogac Lake, and typically biennial (1957-21). A large, upright fruiting specimen was taken from sandy clay of a barren scree slope about 100 m above the southeast side of the lake; it had set seed the previous year (1962-46).

Cardamine bellidifolia L.: Local. 1952-15.

Cardamine pratensis L.: Tiny rosettes of the peculiar leaf of this plant appeared commonly on black mud of drying pools around the lake in early August, 1962. They achieved some vegetative growth, but no flowers were noted. Also collected in the same state in 1952. 1952-79.

Draba crassifolia Grah.: Rare. Found only on two sheltered snow-patch areas. 1962-13.

Draba nivalis Liljebl.: Collected only once, on a dry ledge on the shaded side of the inner lake basin. 1962-17.

Draba lactea Adams: Much the commonest of the genus at Ogac Lake and, as usual, quite variable. 1962-11, 12, 15, 18.

Draba glabella Pursh: The common large draba. 1962-14.

Draba cinerea Adams: Taken only from calcareous cliff rubble on the east side of the lake. The siliques are, atypically, simple-pubescent. 1962-16.

Arabis alpina L.: Common along streams flowing into the lake. 1952-29, 47, 57; 1957-18.

Saxifraga aizoides L.: Common locally; forming dense and extensive mats on steep seepage areas and along rivulets. 1952-27, 63; 1957-43.

Saxifraga Aizoon Jacq. var. *neogaea* Butters: Regular on drier ledges and slopes, but nowhere really common. 1952-53, 54; 1957-37.

Saxifraga caespitosa L.: Plants referable to ssp. *eucaespitosa*. Nowhere very common. 1952-28, 81; 1957-38; 1962-50.

Saxifraga cernua L.: Conspicuous but scattered. 1952-21; 1957-34.

Saxifraga foliosa R. Br.: Found only on otherwise almost sterile, black mud on margins of drying streamlets and ponds in August. None had flowers. Almost all specimens were less than 3-4 cm high, but one of 13 cm was collected. 1962-38.

Saxifraga nivalis L.: 1962-39. This and the four following saxifrages were all well represented at the lake.

Saxifraga oppositifolia L.: 1952-17; 1957-47.

Saxifraga rivularis L.: 1957-46.

Saxifraga tenuis Sm.: 1952-14; 1957-5; 1962-39.

Saxifraga tricuspidata Rottb.: 1952-5; 26; 1957-41.

Potentilla Crantzii Beck: This species is well known in Greenland and northern Ungava-Labrador, but its presence on the Archipelago has hitherto been based on a specimen collected by Kumlien in Cumberland Sound in 1878. In 1962 it was found to be regular around Ogac Lake in typical habitats — in deep grass and among willow shrubs between braided streams and on damp, south-facing slopes. 1962-2, 3, 107.

Potentilla hyparctica Malte: The common cinquefoil in a variety of habitats. 1952-4; 1962-34.

Potentilla nivea L.: Less common than the above, and usually in drier habitats. Plants referable to the typical race. 1962-31, 32, 33.

Potentilla Vahliana Lehm.: A few specimens of this high-arctic species were taken from a south-facing slope on June 27, 1962. These were the earliest blooms of the genus noted, and the species was not found elsewhere thereafter. 1962-1.

Sibbaldia procumbens L.: This species just enters the Archipelago in southeast Baffin Island. It was found in 1962 to be fairly common on the south-facing slope of the inner lake basin and, once noted, was found sparsely in a number of places — even on gravel beaches well above the lake level. 1962-4.

Dryas integrifolia M. Vahl.: 1952-3, 39; 1957-48.

Empetrum nigrum L.: Common. 1952-no field number.

Epilobium angustifolium L. var. *intermedium* (Wormskj.) Fern.: Found only in a dry thicket of *Salix cordifolia* on the south facing slope of the inner basin of the lake. No evidence of flowering when collected on August 15. 1962- 40.

Epilobium latifolium L.: 1952-7, 32, 60; 1957-14, 49. A single specimen of the white-flowered f. *albiflorum* Nathorst was noted and collected by the expedition in 1952 (1952-32). Several white blooms occurred among the typical form at the same site in 1957 (1957-14), but the white form had apparently disappeared in 1962.

Pyrola grandiflora Rad.: 1952-23; 1957-33.

Ledum decumbens (Ait.) Lodd.: 1952-1, 87, 92. This and the following seven heaths are well represented at the lake.

Loiseleuria procumbens (L.) Desv.: 1957-26.

Cassiope hypnoides (L.) D. Don: 1952-10, 51; 1957-51.

Cassiope tetragona (L.) D. Don: 1952-9, 85; 1957-45.

Phyllodoce coerulea (L.) Bab.: 1952-18; 1957-50.

Rhododendron lapponicum (L.) Wahlenb. 1957-25.

Arctostaphylos alpina (L.) Spreng.: 1952-89.

Vaccinium uliginosum L.: 1952-6, 88, 93.

Vaccinium Vitis-idaea L. var. *minus* Lodd.: The only heath which can be said to be rare. 1957-45.

Diapensia lapponica L.: Regular on gravel between rocky ridges. 1952-96; 1957-40.

Armeria maritima (Mill.) Willd. ssp. *labradorica* (Wallr.) Hult.: Rare. A few specimens found on damp cliffs on the fiord in mid-July, 1957, and a few clumps taken from the gravelly brow of a south-facing hill in 1962. 1957-22; 1962-102.

Mertensia maritima (L.) F. J. Gray: A few growing on gravel beaches near the outlet of the lake. 1952-35; 1957-42.

Veronica alpina L. var *unalaschcensis* C. & S.: Formed dense stands on a few moist sites on south-facing slopes, but elsewhere uncommon. 1952-57; 1957-32.

Euphrasia arctica Lge.: Quite common on sunny slopes, but often almost hidden in grassmats. 1952-55; 1957-29.

Bartsia alpina L.: Small local stands. 1952-50; 1957-30.

Pedicularis lapponica L.: 1952-38; 1962-126.

Pedicularis flammea L.: 1952-20; 1957-17.

Pedicularis hirsuta L.: The common lousewort at the lake. 1952-45; 1957-15. I searched for *P. lanata,* but if it occurs it must be rare.

Pinguicula vulgaris L.: A few dozen plants were discovered on August 19, 1962, growing on black soil of a seepage slope facing southeast on the outer basin of the lake. Most had finished flowering. The species is rare on the Archipelago, and apparently hitherto known only from a few specimens collected by Polunin (1940) around Lake Harbour. 1962-47.

Campanula uniflora L.: Although perhaps more widely distributed, this species did not form local concentrations like the following. 1957-27.

Campanula rotundifolia L.: Beautiful thick stands of the species were found at several places in cliff rubble along the east side of the lake and elsewhere. 1952-56; 1957-28.

Erigeron eriocephalus J. Vahl: This high-arctic form was found only once, on a sandy-clay barren, about 400 m up the east side of Knife Edge Mountain. 1962-112.

Erigeron unalaschkensis (DC) Vierh.: The common composite on a wide variety of habitats around the lake. 1952-25; 1957-23; 1962-125.

Erigeron sp.: On August 15, 1962, a stand of several dozen *Erigeron,* quite unlike the above two species, was found below the weathering cliffs on the east side of the lake. Most were past flowering, and attracted attention from a distance by their large white pappus and general robustness. A few late blooms resembled superficially those of *E. eriocephalus* in their large, loose involucres, spreading phyllaries, and dense covering of pale hairs. However, the high-arctic *E. eriocephalus,* which I have seen in abundance on Ellesmere Island, is densely grey-to-white villous, exactly as described in Porsild's (1957) manual, whereas the present specimens are mauve-villous and much more robust. Dr. Porsild (*pers. comm.*) concurs in the opinion that they are not *E. eriocephalus.* It is perhaps significant that *E. eriocephalus* at Ogac Lake (above) was taken on one of the most barren alpine sites examined, whereas the present specimens grew on one of the most warm and sheltered flower slopes, a stone's throw from the first Archipelago record of the subarctic, amphi-Atlantic *Viscaria alpina.* Along with *E. eriocephalus* and *E. humilis* (= *unalaschkensis*), the two "low-arctic, oceanic-montane" species *E. uniflorus* L. and *E. borealis* (Vierh.) are maintained in the current Greenland manual of Böcher *et al.* (1957). Cronquist (1947) described *E. alpiniformis* from Greenland material, but this is considered to be *E. uniflorus* p.p. and *E. borealis* p.p. by Böcher *et al.* (1957). Further *E. uniflorus* and *E. eriocephalus* are considered only subspecifically distinct by some authors, and are not separated at all by others. In my opinion the material from Ogac Lake is referable to *E. uniflorus* L. (s. str.) as described in the recent manuals for Greenland (Böcher *et al.,* 1957) and Iceland (Löve, 1945), and Dr. A. Löve (*pers. comm.*) concurs that it is *E. uniflorus* as he knows it in Iceland. However, there are systematic and nomenclatural problems which preclude any easy decision on such limited material. It is perhaps sufficient to suggest that there is an entity in the Eastern Arctic flora distinct from *E. unalaschkensis* and *E. eriocephalus,* somewhat resembling the latter, but of decidedly subarctic rather than high-arctic habitat. 1962-113.

Antennaria canescens (Lge.) Malte: Collected on dry herbmats on the south-facing slope of the inner basin of the lake. 1962-7.

Antennaria angustata Greene: The common *Antennaria* at the lake. 1952-24; 1957-11; 1962-5, 10.

Antennaria Ekmaniana Porsild: This high-arctic form was taken only on a gravelly ledge on the steep, north-facing slope of the inner basin of the lake. 1962-9.

Artemisia borealis Pall.: Small specimens taken in 1957 from the exposed cliffs of the fiord. Luxuriant collections from river gravel and from cliff rubble along the east side of the lake in 1962. 1957-19; 1962-95.

Arnica alpina (L.) Olin ssp. *angustifolia* (Vahl) Maguire: 1952-2, 48, 83; 1957-20.

Taraxacum lacerum Greene: 1952-42; 1957-10; 1962-48. Both dandelions are common, this species perhaps more around the shores, and the next on sunny slopes.

Taraxacum lapponicum Kihlm.: 1952-49 1962-49.

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PRELIMINARY TRIALS OF A CAMERA RECORDING DEVICE FOR THE STUDY OF SMALL MAMMALS*

C. H. Buckner
Forest Entomology Laboratory, Box 6300, Winnipeg 1, Manitoba

Tests of a stop-lapse camera device for studying the habits of small mammals in forest and bog habitats of southeastern Manitoba were made in 1961. The apparatus was similar to those employed by Pearson (1959), Dodge and Snyder (1960), and Abbott and Dodge (1961). These have been described elsewhere, and shown in photographs at the sites of operation. Examples were also presented by these authors of the individual recordings made by the devices. The apparatus I used was obtained through the joint assistance of the Engineering Research Institute and the Bio-Graphic Unit of the Canada Department of Agriculture. P. W. Voisey, Instrumentation Engineer, Engineering Research Service, Research Branch, Canada Department of Agriculture, Central Experimental Farm, Ottawa, Canada, was responsible for basic construction and design of electrical circuits.

The apparatus consisted of two units: one containing a 16 mm movie camera with electronic photoflash, and a photoelectric cell and light source; the other a small mirror, scale, clock, thermometer and relative humidity gauge. The units were housed in glass-fronted weatherproof shelters. In operation, these were positioned facing each other at a distance of two feet so that the red-light source from the camera unit was reflected back to the photoelectric cell from the mirror unit. Interruption of this beam fired the red light electronic flash and exposed one frame of film. The flash and shutter could also be fired by a treadle tripping device (Voisey and Kalbfleish, 1962) but preliminary tests indicated that the photo cell has greater advantages. The device operated on 120 volt line current and differed from Pearson's model chiefly in the inclusion of an isolation transformer to eliminate a shock hazard.

The apparatus was operated in a tamarack bog from August 2 to 23 inclusive. Preparations included a three-day mark-and-release program one

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week prior to the trial. Trapped animals were marked in the standard manner by toe-clipping, and also by fur-clipping in various patterns for photo identification. Animals marked in this way included two masked shrews, two meadow voles, eleven red-backed voles, two deer mice, two meadow jumping mice, and one red squirrel.

A total of 1,055 exposures were made, not including manual tests, of which 244 were discarded for the following reasons: subject not in camera field, 162 exposures; flash unit failure, 67 exposures; tripping by inanimate objects, 15 exposures. A garter snake and a white-throated sparrow each accounted for one exposure and grey jays for 21. The remaining 788 photos were of mammals, as follows: masked shrew, *Sorex cinereus*, 69 exposures of at least 2 individuals; short-tailed shrew, *Blarina brevicauda*, 4 exposures of at least 1 individual; meadow vole, *Microtus pennsylvanicus*, 28 exposures of at least 2 individuals; red-backed vole, *Clethrionomys gapperi*, 290 exposures of at least 8 individuals; deer mouse, *Peromyscus maniculatus*, 36 exposures of at least 2 individuals; meadow jumping mouse, *Zapus hudsonius*, 11 exposures of at least 2 individuals; red squirrel, *Tamiasciurus hudsonicus*, 181 exposures of at least 2 individuals; least chipmunk, *Eutamias minimus*, 3 exposures of at least 1 individual; snowshoe hare, *Lepus americanus*, 166 exposures of at least 1 individual.

Probably all marked animals were photographed, several of these many times. Ease of identification varied with the position of the subject in relation to the camera and indistinct images of the fur-clipped patches often made identification difficult. Two animals were photographed carrying objects: a red squirrel carrying a spruce cone and a meadow vole carrying a blade of grass.

As an example of information obtained by the technique, Figure 1 shows the relative daily activity of the three most frequently photographed species, as determined by the number and timing of photographs.

The snowshoe hare was active almost exclusively during the periods of darkness, whereas the red squirrel was active only during the daylight hours. In contrast, the red-backed vole was active intermittently during both daylight and darkness. Scanty records on the other species suggest that the masked shrew, the deer mouse and the meadow jumping mouse behave similarly to the red-backed vole. The meadow vole, and the four recordings of the short-tailed shrew, were photographed only at night. The three photographs of the least chipmunk were taken in daylight.

Concomitant readings of temperature and relative humidity on each photograph provide data for more critical analysis of the factors affecting activity. Present data are too limited to employ appropriate multiple regression techniques but provide interesting preliminary indications of the conditions under which the greatest activity occurred. For example, the snowshoe hare was recorded at temperatures ranging from 45°-78° F and relative humidity from 20-68%. The greatest activity occurred within a combination of ranges of 58°-66° F and 37-47% RH and the largest number of individual readings was at 58° F and 40-42% RH.

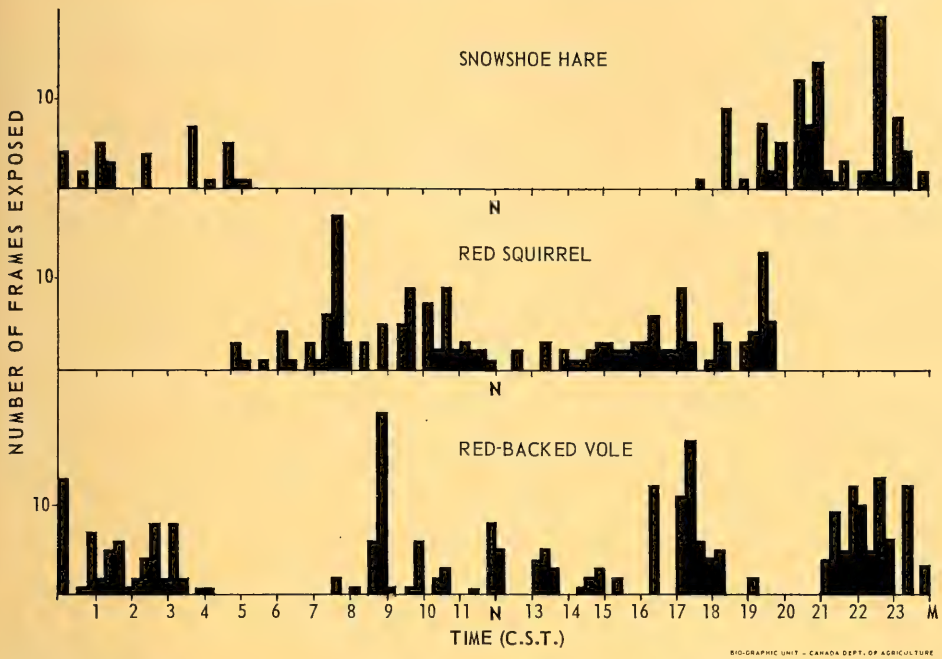
SNOWSHOE HARE
RED SQUIRREL
RED-BACKED VOLE
NUMBER OF FRAMES EXPOSED
10
10
10
N
N
1 2 3 4 5 6 7 8 9 10 11 N 13 14 15 16 17 18 19 20 21 22 23 M
TIME (C.S.T.)
BIO-GRAPHIC UNIT - CANADA DEPT. OF AGRICULTURE

FIGURE 1. Number and time of photo-recordings of three species of mammals, in a tamarack bog, August 2-23, 1961.

Encouraging results from the preliminary tests have warranted further improvements to the equipment. Reliance on line power has been eliminated by converting to battery operation. A re-designed model operates for about a week on a standard 6-volt car battery before recharging and at temperatures of 28° F or lower. Other improvements in the electronic and flash equipment have reduced the incidence of premature and faulty exposures. Experiments are planned to improve identification of marked animals.

The device promises to be of value in behaviour and population studies of small mammals, particularly during the winter when trapping techniques are less feasible. It may also prove useful as a supplementary means of obtaining seasonal population estimates of small mammals on permanent study plots.

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LOCAL DISTRIBUTION OF TWO VOLES: EVIDENCE FOR INTERSPECIFIC INTERACTION

GARRETT C. CLOUGH*
Zoological Laboratory, Dalhousie University, Halifax, Nova Scotia

THE LOCAL DISTRIBUTION of small mammals is often explained on the basis of physiological limitations of the animal to physical factors of the environment. Examples of studies supporting this assumption are works of Pruitt (1953) on the short-tailed shrew, of Getz (1960 and 1961) on voles and shrews, of Bendell (1961) on the deer mouse and of Pearson (1962) on red-backed voles.

Since a species usually does not occupy all of the space which apparently suits its physiological requirements and limitations, other limiting factors must be involved in some cases. Indirect evidence that presence or absence of other species of small mammals may influence the local distribution of small mammals is given by Wirtz and Pearson (1960), Findley (1954), Curry-Lindahl (1959) and Ota and Jameson (1961). Interspecific interactions might be expected to be most important in cases of predator-prey combinations or with species of similar ecology.

The present study was undertaken to learn if two closely related species of voles influenced each other in their local distribution in southern Nova Scotia. The species studied were the meadow vole, *Microtus pennsylvanicus acadicus* and the red-backed vole, *Clethrionomys gapperi pallescens*. Both species are common in Nova Scotia. They are both widespread in North America with *Microtus* extending slightly further north into Alaska and the Northwest Territories and slightly further south into central United States than *Clethrionomys* (Hall and Kelson 1959).

This study was performed between October 1961 and November 1962. Collecting efforts were aimed at areas containing more than one type of habitat. A total of 2769 trap nights contributed to the results. Two introduction experiments were conducted in which *Clethrionomys* were added to isolated areas of mixed habitat which had contained only *Microtus*.

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METHODS AND DESCRIPTION OF AREAS

Field Collections: The collecting was done primarily in Halifax County. Museum special snap traps, baited with peanut butter and rolled oats, were set in lines through the areas. Since the aim of the collecting was to record the presence or absence of the two voles the trapping method sometimes varied from area to area. The trapping details are given below with the description of each collecting site.

*Present address: The Norwegian State Game Research Institute, Vollebekk, Norway.

Habitat Types: The habitats found on the collecting sites were distinguished on the basis of vegetation form and general condition of substrate. These fell into six major types which were subdivided into fourteen habitat types.

I. BOG.

A. *Open Bog.* This was primarily a wet *Sphagnum* mat with sedges and scattered low heaths.

B. *Conifer Bog.* On this habitat black spruce (*Picea mariana*) and larch (*Larix laricina*) grew as low trees on the *Sphagnum* and heath bog.

II. GRASSLAND.

C. *Meadow Grass.* This habitat included moist to mesic areas which had dense covers of grass of various species without a shrub or tree layer.

D. *Dry Grass.* The grass on this habitat was sparse and the soil was dry compared to the previous one. On the well-drained sandy soils of coastal beaches the major grass was *Ammophila.*

III. CONIFEROUS WOODS.

E. *Wet Spruce Woods.* This habitat contained an overstory of white spruce (*Picea glauca*) with black spruce at the wetter edges. The ground and herb layers supported many mosses and ferns. *Sphagnum* often grew in the depressions.

F. *Mature Spruce-Fir Woods.* Balsam fir (*Abies balsamifera*) with either white or red spruce (*Picea rubra*) formed the tree layer of this habitat. Tree cover was usually dense. Withe-rod (*Viburnum cassinoides*) and alder (*Alnus*) were the most common shrubs in the forest openings. Ferns and various annual herbs were common at some seasons.

G. *Open Spruce Woods.* This habitat was the remnant of the mature spruce-fir woods a few years after logging operations had been completed. Only a few trees were standing. The sapling layer was dense with young poplar (*Populus tremuloides*), birch (*Betula*), spruce and fir. *Viburnum* and *Alnus* were common shrubs. Many brush heaps and fallen logs covered the ground.

H. *Dry Spruce Woods.* Spruce which grew on the thin soil of rocky uplands were thinly spaced with branches growing thickly to the ground. Lichens and sparse shrubs grew on spots of exposed bed rock and areas of little soil.

I. *Virgin Hemlock Woods.* In this stand of virgin hemlock (*Tsuga canadensis*) the dense, high canopy of trees allowed little vegetation to grow on the ground below.

IV. MIXED WOODS.

J. *Northern Mixed Woods.* In this habitat the major tree species were *Abies balsamifera, Picea glauca, Pinus strobus, Betula lutea, Acer rubrum* and *Fagus grandifolia.* Topography was varied with moist hollows and drier ridges. The sapling, shrub and herb layers were well developed in places.

V. SHRUB.

K. *Old-field Shrub.* This habitat consisted of thick growths of plants at the shrub layer and almost no herb layer. In one case these shrubs, dense *Spiraea* and goldenrod (*Solidago*), prevented any grass from developing.

L. *Heath Shrub.* This habitat contained various low ericacous shrubs such as blueberry (*Vaccinium*), rhodera (*Rhododendron canadense*), sheep-laurel (*Kalmia angustifolia*), leather leaf (*Chamadaphne calyculata*) and ground heaths such as foxberry (*Vaccinium vitis-idaea*), cranberry (*V. macrocarpon*) or the heath-like crowberry (*Eupetrum nigrum*). This habitat was on drier ground than the Conifer Bog.

VI. ECOTONE.

M. *Grass-Spruce Ecotone.* The edge between Meadow Grass or Dry Grass and Mature Spruce-Fir Woods was often wide enough to contain several trapping stations and therefore was classified as a distinct habitat. This was characterized by spruce and fir trees of different heights widely spaced in grassland.

N. *Bog-Spruce Ecotone.* The Open Bog and Conifer Bog often merged gradually with Mature Spruce-Fir Woods or with Wet Spruce Woods. These areas were composed of a mixture of wet bog with sparsely growing conifer trees of different sizes.

Collecting Sites: The collecting was done on fifteen different areas selected to represent all the habitats containing at least one of the vole species under study. The habitats and method of trapping on each collecting site are described separately below. This material is summarized in Table 1.

1. On the first site a trap line extended from a Conifer Bog through a Bog-Spruce Ecotone into a Wet Spruce Woods. Fifteen traps were placed 25 feet apart in a single line for four nights from October 29 to November 1, 1961.

2. This site included Conifer Bog, Bog-Spruce Ecotone and Open Spruce Woods habitats. Three parallel lines of 15 traps each were set with each line completely within one habitat type only. The traps were spaced at 50-foot intervals and the lines were 50 to 75 feet apart. The traps were set for five nights from November 19 to 22, 1961.

3. This site was entirely within Northern Mixed Woods. Sixty traps were set in groups of three at 20 stations about 10 yards apart in a single line through the woods. The trapping was done for three nights from May 7 to 10, 1962.

4. This site was in a large area of Dry Spruce Woods. Sixty traps were set in groups of three at 20 stations about 10 yards apart. The traps were set for three nights from May 7 to 10, 1962.

5. This trap line was placed in an extensive Mature Spruce-Fir Woods. Fifty traps were set at approximately 10-yard intervals along a line for three nights from May 14 to 17, 1962.

6. This site had two trap lines. One line started in Meadow Grass and passed abruptly into Mature Spruce-Fir Woods and the other line, which also

TABLE 1. — Small mammal catch from 15 collecting sites according to habitat type. The bottom row shows the occurrence of *Microtus* and *Clethrionomys* by habitat type in all sites combined. The last column at the right shows the occurrence of these 2 voles by collecting site with all habitat types combined. Abbreviations: M—*Microtus pennsylvanicus*, C—*Clethrionomys gapperi*, B—*Blarina brevicauda*, P—*Peromysus leucopus*, Sc—*Sorex cinereus*, Sa—*Sorex arcticus*, Mx—*Microsorex hoyi*, T—*Tamias striatus*, G—*Glaucomys sabrinus*.

Collecting Site	Trap nights	Habitat Type														
		Open Bog	Conifer Bog	Meadow Grass	Dry Grass	Wet Spruce Woods	Mature Spruce-Fir Woods	Open Spruce Woods	Dry Spruce Woods	Virgin Hemlock Woods	Northern Mixed Woods	Old Field Shrub	Heath Shrub	Grass-Spruce Ecotone	Bog-Spruce Ecotone	Voles at Collecting Sites
1	60	—	2M 2Sc.	—	—	3C 2Sc, 2P	—	—	—	—	—	—	—	—	1C 1Sc	Both
2	225	—	1Sc.	—	—	—	—	10C 1P	—	—	—	—	—	—	1C, 3Sc	C
3	180	—	—	—	—	—	—	—	—	—	8C, 5Sc.*	—	—	—	—	C
4	180	—	—	—	—	—	—	—	2C 1Sc	—	—	—	—	—	—	C
5	150	—	—	—	—	—	20C 5Sc	—	—	—	—	—	—	—	—	C
6	300	—	—	5M	—	—	2C, 2B	—	—	—	—	2C	—	—	—	Both
7	100	—	—	21M 2B	—	—	—	—	—	—	—	—	—	—	—	M
8	300	—	—	—	1M	—	o	—	—	—	—	—	1M	—	—	M
9	180	—	—	1M	—	—	1M	—	—	—	—	—	2M	1M	—	M
10	180	—	—	4M 8B	—	—	3C	—	—	—	—	—	—	1C, 2B 2M, 1P	—	Both
11	75	4M 2Sc	—	—	—	—	—	—	1C	—	—	—	1C	—	—	Both
12	60	—	—	—	—	—	2C, 2P	—	—	—	—	—	—	—	—	C
13	72	1M	—	—	—	—	—	—	—	—	—	—	—	—	2C, 3P	Both
14	120	—	—	—	—	—	—	—	—	6C, 1M, 1Sc, 3P, 1B	—	—	—	—	—	Both
15	20	—	—	—	—	—	o	—	—	—	—	—	2M	2M	—	M
Post Introduction																
8	270	—	—	—	o	—	5C 2Sc	—	—	—	—	—	3C 2Sc 2P	—	—	C
9	297	—	—	4M 2Sa	—	—	1M	—	—	—	—	—	1M	1M 2Sc	—	M
Voles at Habitat types		M	M	M	M	C	Both	C	C	Both	C	C	Both	Both	C	

*:1Mx, 1T, 1G

started in Meadow Grass, passed through Old-field Shrub and extended up to Mature Spruce-Fir Woods. The lines were parallel and had 10 stations of three traps per station. The stations were 25 feet apart and the lines 450 feet apart. The traps were set for five nights from September 26 to 30, 1962.

7. At this site the trapping was done within a large field of Meadow Grass. One hundred traps were set in a square grid pattern with 25-foot intervals between traps and rows. Trapping was done for one day, September 14, 1962.

8. This site was part of a 110-acre peninsula connected to the mainland by a long narrow spit of sand and pebbles. It contained Dry Grass habitat on the seaward side and on the tops of a multiple series of old beach ridges. In the hollows and flat sections between the ridges there were strips of Mature Spruce-Fir Woods and Heath Shrub habitats. A portion of this area is shown in Figure 1. Sixty traps were set at 20 stations for 3 nights from May 21 to 23, 1962. Half of these stations were in Dry Grass and the rest in the other two habitats.

9. This area was similar to site 8 in its position on a small peninsula separated from the mainland by a long narrow sand spit. It was a low glacial drumlin about 15 acres large. Approximately one-third of the area was Meadow Grass habitat and the rest covered by Heath Shrub, patches of Mature Spruce-Fir Woods with Grass-Spruce Ecotone (Figure 2). Sixty traps were set at 20 stations for three nights from May 21 to 23, 1962. Half of these stations were set in Dry Grass and the rest distributed through the other three habitats.

10. This site was situated along a section of high, rocky seacoast. The trapping was done partly in a 35-foot wide strip of Meadow Grass on the open knoll above the cliff, and partly in the Grass-Spruce Ecotone and Mature Spruce Woods behind the grass. Three lines of five stations each extended perpendicular to the shore line from the open grass in the woods. The stations were 10 yards apart with three traps per station. The traps were operated for four nights from December 1 to 4, 1961.

11. This site was near a lake in a barren, rocky section of land a few miles from the coast. The collecting was done partly in a low area of Open Bog and partly on the hillside at the edge of the bog which was covered with Dry Spruce Woods and Heath Shrub habitats. One line of 30 traps at 10 stations placed at 10-yard intervals was set entirely within the bog and the other was set in the same manner 50 yards away on the slope. The traps were set for one night, October 17, 1962.

12. This site and the following two (13 and 14) were in the Tobeatic Game Preserve in Queens County. The trapping on these three sites was done for two days on October 7 and 8, 1962. This site (12) was entirely within an extensive Mature Spruce-Fir Woods. Ten stations of three traps each were set at 15-yard intervals.

13. The collecting in this site was done in an Open Bog at the edge of a lake. The last station in the line was at the edge of Mature Spruce Woods. Twelve stations with three traps per station were set at 10-yard intervals.

FIGURE 1. Collecting site 8. Dry Grass and Mature Spruce-Fir Woods are shown. Heath Shrub is in the hollows in the background.

FIGURE 2. Collecting site 9. This view extends from Meadow Grass habitat through Spruce-Grass Ecotone to Mature Spruce-Fir Woods.

14. This site was within a Virgin Hemlock Woods situated along the bank of a river. Twenty stations of three traps each were set at 10-yard intervals. The last two stations were on the river bank.

15. The last collecting site was on an island about six miles off the coast of eastern Halifax County. Most of the island's 35 acres were covered with Mature Spruce-Fir Woods. In a protected hollow there was one acre of Grass-Spruce Ecotone. Along the island shore in some places there was a strip of Heath Shrub 10 to 20 yards wide. Most of this was crowberry growing in a thick green mat six to eight inches high. The trapping was done in the ecotone and shrub habitats on May 23 and 24, 1962. Ten traps were set each night.

Introduction Experiments: Collecting sites 8 and 9, the two peninsulas, supported *Microtus* but no *Clethrionomys* at the time the first collecting was done. This fact, together with their relative isolation from the mainland and their mixture of grassland, woodland and ecotone habitats, was utilized in the performance of introduction experiments. On June 6, 1962, 12 *Clethrionomys* (4 adult females, 6 adult males and 2 immature animals) were released at four points in the Spruce Woods of Site 8. On the same day 10 *Clethrionomys* (4 adult females and 6 adult males) were released at three points in the Spruce Woods of site 9.

Four months later, from October 10 to 12, 1962, snap trapping was conducted on site 8. Three lines of 15 stations, each with 3 traps, were set through all habitat types. From October 27 to 31 trapping was done on site 9. Three lines with a total of 33 stations, each with 3 traps, were set through all habitat types. In both sites some stations were placed at the original points of *Clethrionomys* release.

RESULTS

Field Collections: The small mammal catch for each collecting site is presented in Table 1 according to habitat type. Seven other species besides the two voles were found. Possibly interactions between the two voles and these other species of mammals are important in determining local distribution. In this paper I am assuming that these other interactions, if they do exist, would not change the influence of the two voles on each other.

On five collecting sites (2, 3, 4, 5 and 12) *Clethrionomys* was found without *Microtus*. On four sites (7, 8, 9 and 15) *Microtus* was found without *Clethrionomys*. On the remaining six sites both species of voles were collected. Close examination showed that on these latter sites the two species usually did not occupy the same habitat type. The only instances of coexistence within a single habitat at the same collecting site come in the Virgin Hemlock on site 14 and in the Grass-Spruce Ecotone on site 10. The first case involves only one specimen of *Microtus*. This animal may have wandered into the forest from the river bank where more ground vegetation grew. It was collected in the fall when some small mammals tend to disperse from their home ranges into unfamiliar areas. In the second case of coexistence the two species were not captured at the same station in three nights.

The comparative distribution of the two voles by habitat type is shown by the sum of the columns in Table 1. Four habitat types contained only *Microtus*, six contained only *Clethrionomys* and four habitat types (Heath Shrub, Grass-Spruce Ecotone, Mature Spruce-Fir Woods and Virgin Hemlock Woods) had both species of voles. *Clethrionomys* and *Microtus* had some exclusive habitats but they both occupied certain other habitats. However, the two species usually did not coexist in those habitats which both of them were able to occupy.

Introduction Experiments: Four months after the introduction of *Clethrionomys* to site 8 the trapping yielded *Clethrionomys* but no *Microtus* (Table 1). Some of the *Clethrionomys* collected were the marked animals of the introduction and others were unmarked juveniles. Presumably these were offspring of the introduced animals. The animals were taken in Mature Spruce-Fir Woods and Heath Shrub habitats.

On site 9 the post-introduction trapping results were quite different. Here *Microtus* was taken but no *Clethrionomys*. The *Microtus* still occupied the same habitats which they had previously: Meadow Grass, Mature Spruce-Fir Woods, Heath Shrub and Grass-Spruce Ecotone.

The results of these experiments support the two conclusions drawn from the field collections that, (1) both species of voles are able to live in certain habitats and, (2) that they usually do not coexist in these habitats.

DISCUSSION

Clethrionomys gapperi usually lives in woodlands and *Microtus pennsylvanicus* in grasslands although they both have been found living together in other habitats. Buckner (1957) trapped both species in tamarack bogs in southeastern Manitoba, Connor (1960) found both in arbor vitae swamps in New York and Smith and Foster (1957) found both in some woodland habitats at Churchill, Manitoba. Beer, Lukens and Olson (1954) collected both species on small wooded islands in Minnesota. In all these places the main distinction between optimum habitats was preserved with *Clethrionomys* most abundant in conifer and mixed woods and *Microtus* most abundant in grasslands. The overlap of local distribution was only partial.

Other field studies contrast to these records of partial compatibility of the two species. The differences in local distribution of one vole in places where the other is absent compared to the local distribution in places where both species are present imply incompatibility. On Cape Breton Island, Nova Scotia, *C. gapperi* was most abundant in woodlands while *M. pennsylvanicus* was most abundant in grassland (Cameron, 1958). However, on Newfoundland, where *Clethrionomys* is absent, Cameron found that *Microtus* at high population levels, expanded their habitats to include bogs, swamps and woodlands. A similar situation occurred with members of these two genera in Japan. On the island of Honshu *C. andersonii* inhabited coniferous woods and *M. montebelli* inhabited grasslands. On Hokkadio Island, where *M. montebelli* is absent, another species of *Clethrionomys*, *C. rufocanus*, occupies grasslands as well as woodlands (Ota and Jameson, 1961). My study here gives additional circumstantial evidence of incompatibility between *C. gapperi* and *M. pennsylvanicus*.

Thus, in some places and in some circumstances, these two voles seem compatible while in others they may be incompatible. There is obviously an overlap in physiological tolerances and needs in the two species. Behavioral conflict may sometimes prevent them from coexisting in those places which both are capable of occupying alone. Such aggressive conflict between species of small mammals has been shown in the laboratory by King (1957) with *Mus* and *Peromyscus* and by Getz (1962) with *Microtus pennsylvanicus* and *M. ochrogaster*. Both authors suggest that behavioral aggression may account for the spatial separations of these species in the field.

We need much further study on the exact nature and mechanisms of interspecific interactions to learn why these two species of voles are apparently mutually exclusive in some parts of their joint ranges and not in other parts. There are two profitable lines to follow. One is to study wild populations by following movements and survival of marked individuals in populations manipulated by introductions and removals. Small islands with mixed vegetation offer ideal outdoor laboratories. The second line of study is to observe the social behavior of the animals in captivity.

SUMMARY

The local distribution of the meadow vole, *Microtus pennsylvanicus*, and the red-backed vole, *Clethrionomys gapperi*, was studied in southern Nova Scotia. Collecting was done by snap trapping on 15 sites which contained 14 different habitat types. Two field experiments were conducted in which *Clethrionomys* were introduced to peninsulas of mixed habitat occupied by *Microtus*. In general, *Clethrionomys* occupied woods and *Microtus* occupied grass and bogs but both species were found in heath shrub, grass-spruce ecotone and mature spruce-fir woods. However, they almost never coexisted in these habitats of ecological overlap. This suggests a partial behavioral incompatibility between the two species.

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NEW BIRD RECORDS FROM CAPE BRETON ISLAND, NOVA SCOTIA

ANTHONY J. ERSKINE
Canadian Wildlife Service, Sackville, New Brunswick

GODFREY (1958) PUBLISHED DATA ON 189 species of birds reported in Cape Breton Island, Nova Scotia, through 1954. Tufts (1962) and Cameron (1963) reported Cape Breton records for four species not listed by Godfrey. This paper presents sight records of twenty-five species of birds not reported in Cape Breton by those authors, and breeding records of five species not previously known to breed on that island. Additional records are also presented for three species whose status in Cape Breton was considered hypothetical or doubtful by previous authors.

Canadian Wildlife Service biologists, including the late George F. Boyer, Brian C. Carter, Charles O. Bartlett, and the writer, have made surveys of waterfowl in Cape Breton during the years 1949-63. Unpublished data from our field notes have provided most of the new records. Other records were obtained from J. E. V. Goodwill (*MS*), and from the Nova Scotia Bird Society newsletters. All records not otherwise credited below are those of the writer. No specimens were collected, but my own identifications were made carefully, since I was aware of their significance.

Gavia stellata RED-THROATED LOON: Uncommon transient. One winter plumaged bird at Mabou, Inverness Co., April 29, 1961; one at the Strait of Canso, Inverness Co., November 8, 1962 (Goodwill, *MS*).

Butorides virescens GREEN HERON: Casual. One at Whycocomagh, Inverness Co., June 2, 1961.

Florida caerulea LITTLE BLUE HERON: Casual. One immature at Whycocomagh, August 15, 1961 (R. S. Gibbon and the writer). *Chen caerulescens* BLUE GOOSE: Casual. Two at Little Judique Ponds, Inverness Co., October 7, 1961. My field notes state that one bird had a dark body and the second had a light-coloured belly. Tufts (1962) gave only one record for the province of Nova Scotia.

Anas platyrhynchos MALLARD: Uncommon in spring and summer. C. W. S. biologists have at least nine records, all of adult drakes except one eclipse-plumaged bird, in most cases apparently paired with Black Ducks *Anas rubripes*. Seasonally, the earliest was April 21, 1961, at Inverness, and the latest August 26, 1962, at Margaree Harbour, both in Inverness Co.

Anas acuta PINTAIL: Uncommon transient. Seasonally, spring records extend from May 7, 1961, one drake at the Strait of Canso, to May 21, 1961, a pair near Kenloch, Inverness Co.; fall records ranged from September 24, 1960, 19 birds at River Denys, to October 7, 1961, one at Judique North, both locations in Inverness Co.

Anas carolinensis GREEN-WINGED TEAL: Not previously known to breed. C.W.S. biologists have brood records from Kenloch, Whycocomagh, Nyanza (Victoria Co.), and North Sydney and Mullcuish Lake, in Cape Breton Co.

Spatula clypeata SHOVELER: Casual. A pair near Margaree Forks, Inverness Co., June 7, 1963.

Aix sponsa WOOD DUCK: Uncommon. Breeds. C.W.S. biologists have spring and summer records, from April 24, 1961, one drake at River Denys, to August 18, 1962, two at McCormack, Inverness Co. Broods have been seen at Nyanza — a female with 11 half-grown young, July 24, 1956 (Carter and J. K. Lowther), and at River Denys — a female with nine one-third grown young, July 21, 1961.

Aythya marila GREATER SCAUP: Common in fall and winter, uncommon in spring. The earliest and latest seasonal records are of 210 at Mullcuish Lake, October 6, 1961, and two pairs at Scotsville, Inverness Co., May 26, 1956 (J. K. Lowther). 430 off Big Pond, on the Bras D'Or Lakes, January 16, 1963, is the largest number reported.

Bucephala islandica BARROW'S GOLDENEYE: Casual. One drake and two females on the Margaree River near Margaree Forks, April 20, 1961.

Bucephala albeola BUFFLEHEAD: Uncommon in winter. Two drakes and one female at Margaree Harbour, December 13, 1960; a courting group of seven males and 11 females at Framboise Cove, Richmond Co., January 15, 1963.

Somateria spectabilis KING EIDER: Listed by Godfrey (1958) as hypothetical. A specimen in the Nova Scotia Museum of Science was collected at St. Paul Island in 1896, by W. D. Farquhar.

Oxyura jamaicensis RUDDY DUCK: Uncommon fall transient. One near East Margaree, Inverness Co., November 5, 1957 (Carter); one at Little Judique Ponds, October 7, 1961.

Lophodytes cucullatus HOODED MERGANSER: Uncommon fall transient. Tufts (1962) stated that James Bond's records, cited by Godfrey, have since been withdrawn by Bond. One female or sub-adult at Nyanza, September 25, 1960; a group of three males and one female at Whycocomagh, October 5, 1961.

Totanus melanoleucus GREATER YELLOWLEGS: Probably breeds. J. S. Erskine (letter, July 28, 1956) wrote that he saw a small downy young believed to be a Greater Yellowlegs swim across a pond, while adults screamed overhead, near Lake of Islands, Victoria Co., on the Cape Breton plateau, July 20, 1956. That record was incompletely cited by Tufts (1962), who made no mention of the young bird.

[*Erolia bairdii* BAIRD'S SANDPIPER: One at Nyanza, September 12, 1956 (J. K. Lowther, 1956, unpublished mimeographed report, Canadian Wildlife Service). This species is rare anywhere in Nova Scotia (Tufts, 1962) and is easily confused with other sandpipers. Without a specimen, its status in Cape Breton is best treated as hypothetical.]

Erolia alpina DUNLIN: Regular transient, scarce in spring. One in breeding plumage at Point Michaud Beach, Richmond Co., June 8, 1963; 42 at the same place October 4, 1961, and 12 at Big Glace Lake, Cape Breton Co., October 6, 1961.

Limosa haemastica HUDSONIAN GODWIT: Uncommon fall transient. Laidlaw Williams (letter, October 13, 1963) saw this species on four occasions at Port Morien, Cape Breton Co., the earliest and latest dates being August 6, 1951, and September 5, 1950. The greatest number was 24 on August 20, 1951. One at Big Glace Lake, August 5, 1963; three there, and two at Framboise Cove, October 6, 1961; two at Little Judique Ponds, October 7, 1961. John Lunn (*fide* A. M. Bagg, letter, October 6, 1963) saw single birds near Louisbourg, Cape Breton Co., September 2 and 29, 1963.

Larus glaucoides ICELAND GULL: Winter visitant. Eight at North Sydney, November 1. 1962, and up to 25 at the Strait of Canso, November 3-8, 1962 (Goodwill, *MS*): seven at the latter place, January 18, 1963.

Hydroprogne caspia CASPIAN TERN: Casual. One at East Lake Ainslie, Inverness Co., September 24, 1960.

Columba livia ROCK DOVE: Omitted, probably intentionally, by Godfrey (1958). Common in urban areas around Sydney, Cape Breton Co., but uncommon and very local elsewhere—noted only at Baddeck, Victoria Co., and at Whycocomagh, Inverness, Port Hastings, and Port Hawkesbury, in Inverness Co. Strayed carrier pigeons seem to be the only Rock Doves seen in rural areas.

Tyrannus verticalis WESTERN KINGBIRD: Casual. One at Big Intervale, Inverness Co., September 2, 1961 (J. B. Hardie, *in* N.S. Bird Society newsletter). That species is reported each autumn in Nova Scotia and is not likely to be confused with other, more common species.

Sayornis phoebe EASTERN PHOEBE: Listed as hypothetical by Godfrey (1958). Casual. One near Breton Cove, Victoria Co., July 28, 1958 (M.R. Bates, *in* Tufts, 1959). One at Island Point, Victoria Co., and one at Alba, Inverness Co., July 27, 1960 (T.F.T. Morland). One at Portree, Inverness Co., May 19 and 20 and June 1, 1962; one at Nyanza, May 28, 1963.

Dumetella carolinensis CATBIRD: Probably breeds. Three birds, believed to be one adult and two juveniles, on the basis of behaviour and appearance, on August 14, 1962, at Glendyer, Inverness Co., where adults had been noted June 4 and July 21 in that year.

Bombycilla garrulus BOHEMIAN WAXWING: Casual. One at a feeding station in Baddeck, January 23-28, 1961 (Mrs. M. W. MacRae, *in* N.S. Bird Society newsletter). This species, and the Towhee cited below, are quite distinctive, although neither is more than casual on the Nova Scotia mainland. Since the birds were observed at close range for several days, there seems to be no reason to question these records.

Vireo philadelphicus PHILADELPHIA VIREO: Casual. One at Big Intervale Cape North, Victoria Co., July 9, 1963. Tufts (1962) gave only three records for the province of Nova Scotia. The description I wrote on the spot reads —"dark olive back, darker cap, eye not red, dark line through eye with lighter line above, yellowish throat, belly whiter", and the song of the bird was much harsher than those of other vireo species in the area.

[*Vireo gilvus* WARBLING VIREO: One near Ingonish Beach, Victoria Co., July 27, 1958 (M.R. Bates, *in* Tufts, 1959). No specimen exists for that easily confused species on even the mainland of Nova Scotia. Without further details, its status in Cape Breton should be considered hypothetical.]

Spinus pinus PINE SISKIN: Not previously known to breed. A fledgling, bobtailed, and unable to fly more than a few yards, at Big Intervale Margaree, June 19, 1961. That bird was captured, and released after examination.

Piplio erythrophthalmus RUFOUS-SIDED TOWHEE: Casual. One at a feeding station in Baddeck, December 29, 1960, to January 2, 1961 (Mrs. M. W. MacRae, *in* N.S. Bird Society newsletter). See remarks above under Bohemian Waxwing.

Chondestes grammacus LARK SPARROW: Casual. Laidlaw Williams saw one at Plaster Mines, near Baddeck, Victoria Co., August 30, 1961. John Lunn (*fide* Aaron M. Bagg, letter, October 6, 1963) saw an adult near Louisbourg, Cape Breton Co., September 2, 1963.

Calcarius lapponicus LAPLAND LONGSPUR: Regular transient and winter visitant, along the outer coast of Cape Breton Country. Three at Big Glace Lake, and 35 at Port Morien, October 6, 1961; three at Big Glace Lake, January 15, 1963; two pairs in summer plumage at Louisbourg, April 25, 1961.

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POTENTILLA STIPULARIS L. AND *DRABA SIBIRICA* (PALL.) THELL. NEW TO NORTH AMERICA

A. E. PORSILD
National Museum of Canada, Ottawa, Ontario

IN THE EASTERN North American Arctic, high mountains or elevated plateaux are notoriously unrewarding places for the botanist looking for new or rare plants. The reason clearly is that most, if not all high mountains there, were overridden by glaciers during the Pleistocene and that no large plant refugia were available from which their floras could be replenished after the ice had retreated. Thus, in Greenland, Labrador and Baffin Island, the number of plant species decreases progressively from sea-level upwards; there is no very apparent altitudinal zonation, and at or near the summit of high mountains, the plant cover is sparse and depauperate, composed entirely of ubiquitous, wide-ranging arctic-alpine species. Such plant refugia as may have existed in the eastern North American Arctic during the Pleistocene, must have been near sea-level rather than on the frigid and windblown summits of mountains protruding above the ice caps. In western Ellesmere and Axel Heiberg Islands, situated in the rain-shadow of the eastern coast ranges of Ellesmere Island, the lowland vegetation is often sparse whereas a surprisingly rich and luxurious plant cover may be found at elevations between 2,000 and 2,400 feet, even

though the site may show signs of comparative recent glaciation. The richer alpine plant cover owes its existence there partly to the adequate moisture from a more abundant precipitation, or to run-off from snow-fields, and partly to temperature inversion commonly observed over large parts of the Arctic Archipelago where, from June through August, a low-hanging cloud cover, averaging 70-80 per cent (Rae, 1951), greatly reduces the amount of solar radiation reaching the lowland (Porsild, 1955). The relatively rich plant cover of some alpine plateaux of these northern islands is, however, composed very largely of the species found also at sea-level.

By contrast, the unglaciated mountain plateaux of Alaska, Yukon, the Mackenzie District and northern British Columbia, have for some time been known to harbour floras richer and more varied than those of the intervening valleys. Thus, in alpine herbmats of the Pelly Mountains in southeastern Yukon, the writer counted 111 species of vascular plants within a radius of 100 feet, few of them found in the forested valley below.

During the Pleistocene, or at any rate during the last advance of the ice in Wisconsin time, the upper limit of valley glaciation in Yukon roughly coincided with the present timberline, or roughly with elevations between 4,500 and 5,600 feet above sea level (Porsild, 1951). The climate at this time must have been sufficiently favourable for the plateaux above the ice to have served as refugia for numerous arctic and alpine species for, otherwise, it would be very difficult to explain how the endemic or widely disjunct species, for which these plateaux are renowned, could have arrived in post-Pleistocene time. When a more favourable climate caused the valley glaciers to retreat, arctic and alpine tundra plants probably were the first to occupy the valleys; but they were soon succeeded by the more aggressive and xerophytic forest- and-grass-land species that today dominate the lowland and valley sites.

Due to greatly improved means of transportation and to more readily available funds for field work, few places on the North American continent are today inaccessible to plant collectors. Nevertheless, despite the considerable amount of collecting of recent years, by professional and amateur botanists, the mountain fastnesses of Alaska, Yukon, Mackenzie District and northern British Columbia may still yield botanical surprises and unexpected rewards. Two such wholly unexpected discoveries are reported in the following pages.

Dr. and Mrs. Raymond D. Wood of Salt Lake City, Utah, lately of Mount Kisco, N.Y., for a number of years have made extended summer forays into the North American Arctic for the purpose of photographing wild flowers in colour. During four summers in the Canadian North and one in West Greenland, the Woods succeeded in photographing 354 species of arctic phanerogams and ferns, many of them never before photographed in colour. A complete duplicate set of their colour transparencies, all in 2¼ x 2¼″ format, now numbering well over 750 slides, together with carefully collected herbarium vouchers, being the original specimens photographed, have been presented to the National Herbarium of Canada. Due to the technical skill and forethought with which these transparencies were made, this unique collection of plant portraits

and photographs of plant habitats constitutes an invaluable research "tool" for present and future botanists engaged in the study of arctic plants.

In 1961, Dr. and Mrs. Wood visited the north slope of the Brooks Range, Alaska, where, since the establishment of the Point Barrow Arctic Laboratory, a number of botanists have been active. Plants were collected and photographed in the vicinity of Point Barrow, near Umiat on the middle Colville River, at Meade River southwest of Barrow, and at Schrader Lake near the east end of the Brooks Range, not far from the Canadian border. In 1962 the Woods again visited Alaska when extended visits were made to the east shore of Bering Strait near Cape Thompson and to Anaktuvuk Pass in the central Brooks Range.

Among the highlights of the combined collections of 265 species of Alaskan plants are excellent representations of several rare plants thus far known only from a few stations in N.W. America and E. Asia, among them flowering and fruiting *Anemone multiceps*, the E. Asiatic *Androsace ochotensis* and *Koeleria asiatica* and a fine series of the Alaskan endemic, *Oxytropis kuyukukensis*, a probably undescribed scapiform *Papaver*, a curious new *Senecio* and, perhaps most interesting of all, a perfectly distinct Siberian cinquefoil new to North America.

Flowering specimens and photographs of *Potentilla stipularis* L. (Figure 1) were obtained on June 30, 1961, one mile west of Umiat, where it grew on wet, sandy loam (R. D. Wood, No. 403, CAN). The Umiat collection is a perfect match for Lehmann's fine illustration (Lehmann, 1856, tab. 46) as well as for representative Siberian specimens in the National Herbarium of Canada, from the lower Lena River Valley near Jakutsk on the Lena River, and from the northern Ural Mountains near Vorkuta. The range of *P. stipularis* given in Fl. USSR, Vol. 10 p. 193 is as follows: Arctic Siberia east to Chukotsk; W. Siberia, Ob; E. Siberia Yenisei, Lena-Kolyma east to Angara-Sajan.

Unknown to Dr. Wood, *P. stipularis* had been collected at Umiat already in 1960 by Drs. Kjeld Holmen of the University of Copenhagen, Denmark, and O. Mårtensson of the University of Uppsala, Sweden. Their discovery is reported here by kind permission of Dr. Holmen.

As far as I know, the only previous reports of *P. stipularis* from outside the USSR is from the northeast coast of Greenland where it was collected first on Clavering Island, in appr. latitude 74° N. (Th. Sørensen, in Gelting, 1934, p. 112 and tab. 4, map fig. 12). The single specimen upon which the report is based, is in prefloral state and by its robust growth and broad leaflets differs so much from Siberian *P. stipularis* that it has been described as a distinct taxon, var. *groenlandica* Th. Sør. In 1958, Kjeld Holmen and Simon Lægaard added another East Greenland station, in innermost reaches of Scoresby Sound, approximately latitude 71° 02′ and longitude 27° 45′, where *P. stipularis* grew on a south-exposed slope with *Cerastium alpinum*, *Carex rupestris*, *Campanula rotundifolia*, *Salix glauca*, *Saxifraga nivalis*, *Draba aurea*, *Potentilla nivea* and *Euphrasia* sp.

The occurrence at Umiat, of *P. stipularis*, although unexpected and puzzling, is not unprecedented, however, inasmuch as a number of other

FIGURE 1. *Potentilla stipularis* L. 2/3 natural size (from Umiat, Alaska).

Siberian plants are known to occur in isolated and widely disjunct stations on both sides of Bering Strait. In view of the inland remoteness of the Alaskan station for *P. stipularis*, recent introduction into Alaska by human agencies or by spontaneous natural dispersal, can almost certainly be ruled out.

Draba sibirica (Pallas) Thellung, another Siberian plant new to the flora of North America, was collected in 1963 in the Ogilvie Mountains 120 miles northwest of Dawson, Yukon Territory, in rich alpine meadows, elev. 5540′, by P. M. Youngman and G. Tessier of the Zoology Section of the National Museum.

The single specimen showing flowers and young fruits, is a perfect match for specimens in the National Herbarium of Canada from northern Ural Mountains and the Lake Baikal region of the USSR. On the flat calcareous summit of unglaciated Ogilvie Mountains, *Draba sibirica* grew in rich alpine meadows or herbmats, associated with *Cardamine purpurea*, *Pedicularis lanata*, *Parrya nudicaulis* and *Aconitum delphinifolium*.

By its matted habit, long, creeping stolons terminating in leafy rosettes, by its yellow flowers on naked peduncles and, above all, by its appressed, bifurcate (malpighiaceous) hairs, attached by their middle (as in the genus *Erysimum*), *D. sibirica* differs from all other arctic or boreal *Drabae* (Figure 2).

Strangely enough, *Draba sibirica*, in common with *Potentilla stipularis*, outside the USSR, otherwise is known only from a single station in East Greenland, in approximately latitude 71° N. where it is abundant locally at the head of Hurry Inlet north of Scoresby Sound (Kruuse, 1905, p. 162). The range given for *D. sibirica* in Fl. USSR is: Novaya Zemlya and arctic Siberia; boreal northern European Russia; Caucasus and E. & W. Transcaucasus; east and west Siberia, south in central Asia to the Mongolian border and east to the Sea of Okhotsk.

The Cordilleran *Phyllodoce glanduliflora* (Hook.) Cov., new to the flora of Yukon Territory, but known from adjacent parts of the Mackenzie District and British Columbia, was collected by Messrs. Youngman and Tessier on the Little Hyland River, 125 miles north of Watson Lake, elevation 4,000 feet.

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FIGURE 2. *Draba sibirica* (Pall.) Thell. approximately 2 times natural size (from O. Gelert, Bot. Tidsskr. vol. 21, 3, fig. 9, 1898).

VOLE POPULATIONS IN SOUTHWESTERN ONTARIO*

ROBERT H. STINSON
Department of Zoology, University of Western Ontario, London, Ontario

VOLES OF THE GENUS *Microtus* have long been noted for their periodic outbreaks in different parts of the world, often causing great damage to cultivated crops. Elton (1942) and Chitty (1960) have summarized much of the literature and speculated as to the causes of such fluctuations. In North America peak populations have been studied by Hatt (1930), Hamilton (1937a) and, more recently, Beck *et al.* (1959) who have described the spectacular increase which occurred in Oregon in 1957-58. In Ontario the meadow vole, *Microtus pennsylvanicus pennsylvanicus* Ord, has been a continual source of damage in orchards and nurseries, girdling trees particularly where they have been planted in heavy sod. In 1956-57 and 1957-58 high numbers of mice occurred in scattered areas in southwestern Ontario and in 1958-59 at the eastern end of Lake Ontario. As is usually the case, concentrations of animals were rarely observed directly, but damage to trees and crops, evident after the snow had gone, indicated their presence. The occurrence of such damage in tree plantations of the Ontario Department of Lands and Forests led to studies in 1957 and 1958 of vole populations in these areas. The following paper is an account of two studies, (1) a trapping survey of plantations, and (2) a description of the characteristics of a high population.

SURVEY OF PLANTATIONS

In 1958 an attempt was made to obtain an index of vole populations in the tree plantations of the Lake Erie, Lake Huron and Lake Simcoe Districts of the Department, in order to discover the frequency of occurrence of voles and to determine whether any relationship existed between the population index and subsequent damage in the area. The plantations were generally less than eight years of age, and contained chiefly white pine (*Pinus strobus*), red pine (*P. resinosa*), jack pine (*P. bansksiana*), Scotch pine (*P. sylvestris*), white spruce (*Picea glauca*), white cedar (*Thuja occidentalis*), and European larch (*Larix decidua*).

In July and again in October single lines of 30 Victor snap traps, at 12 foot intervals, baited with peanut butter and oatmeal, were set out in selected areas of 76 plantations by personnel of the Department of Lands and Forests. A line was examined once a day for three days and all small mammals taken were preserved in 10 per cent formalin for later identification and measurement.

The distribution of the lines by counties is shown in Figure 1 with the total number of voles taken on each line. In 95 per cent of the three-day trapping period fewer than six voles were taken in any one period, but in July single lines in Ontario, Perth and Elgin counties caught 13, 19 and 21 respectively, and in October one line in Middlesex county caught 15 animals. Apart

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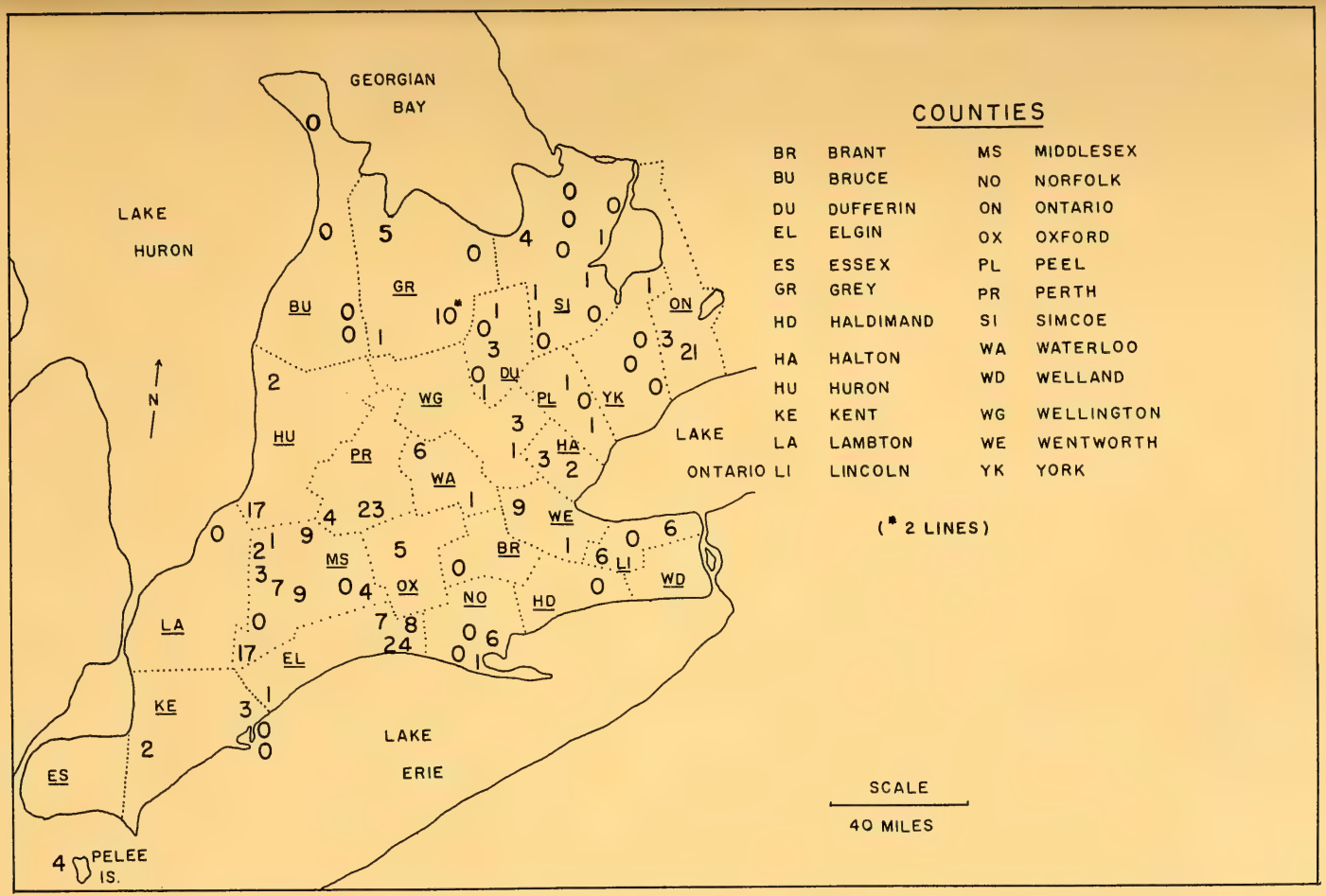

FIGURE 1. Distribution of 253 voles taken with 76 traplines in southwestern Ontario, July and October 1958.

FIGURE 2. Distribution of size and reproductive state of 320 voles trapped in southwestern Ontario, July and October 1958.

from these lines, which may represent "pockets" of high numbers, the average population in the plantation areas was probably low judging from the population index of Beer and MacLeod (1961). Although their trapline method differed in some detail from that of the present study, they give a figure of 25 voles per 1000 trap-station-days as representing a "moderate level" of population. Excluding the above four lines, the plantation survey produced 14 voles per 1000 trap-station-days.

Voles were trapped in 49 of the 76 plantation areas and appeared in more lines and in greatest average numbers per line in the Huron-Perth-Middlesex-Elgin area. For example, when Middlesex with 10 and Simcoe county with 11 lines are compared, the former yielded 52 but the latter only eight animals.

The likelihood of higher populations in the south-central area in 1957-58 was also suggested from the results of a questionnaire sent out to District Foresters and Agricultural Representatives across the area of Figure 1 asking for reports of damage. Of the 44 reports received of damage to trees from 1956 to 1958, 32 came from the four counties mentioned above plus the adjacent counties of Waterloo and Oxford. They described the girdling of trees in plantations and orchards, particularly where they were growing in heavy sod or with the addition of mulch. The Scotch pine was the tree most frequently attacked in the plantations and the apple in the orchards. Two other observations of interest were made in these reports; damage occurred whether or not a heavy snow cover was present, and the gnawing of trees began in September and October at a time when there was an abundant supply of grass.

The possibility that the amount of damage in an area bore some relationship to the trapline catch was examined in April and May 1959. As soon as the snow had gone, a survey was made by personnel of the Department for signs of recent attacks upon trees in the immediate neighbourhoods of 21 lines of the Lake Erie District. Damage was found in 12 of the plantation areas but it was evident that no correlation existed between the extent of such damage and the number of voles taken in the previous year. Along one line in Kent county on which three voles were caught in 1958, 2500 young Scotch pine seedlings were destroyed in the following winter, whereas on a line in Middlesex county no damage occurred although 15 voles had been taken in the three-day period of the previous October. The lines, of course, trapped only a limited area and gave no indication of damage which might occur in other parts of a plantation. In fact, from the pattern of destruction in some plantations, there was evidence that the voles had invaded the area during the winter from adjacent cover of tall grass and swamp.

When received for examination the carcasses were hardened and somewhat distorted by the preservative. In order to estimate the effect of this treatment upon the measurement of body length, a number of voles taken on local traplines were measured before and after a period of several weeks in 10 per cent formalin. Slight shrinkage did occur, on an average four per cent of the body length, so this amount was added to the measured body length in each case. The preserved condition also made it difficult to determine the state of the vaginal opening in the females and the presence of placental scars; hence

only obvious pregnancies were recognized. The reproductive state of the male was judged by the size of the testis following the description of Hamilton (1937b) that sperm were never found in the epididymis if the testis was less than 8 mm in length. This size has been used as the criterion of reproductive maturity but in 90 per cent of the males there was no difficulty in separating the testes into two size groups, one of 3-4 mm and another of 12-16 mm.

Of the 320 voles examined, 242 came from the trapping survey and 78 from five traplines set out in July in areas of thick grass within a one-mile radius of the University of Western Ontario. In Figure 2 is shown the distribution of size and reproductive condition of these animals. The size classes are the same as those used by Beer and MacLeod (1961) who trapped voles at monthly intervals through the year. Even with the use of preserved material, there is considerable agreement with their data.

It is apparent that while females in the 90-94 mm range (24 days of age, Beer and MacLeod, 1961) can become pregnant, the level of pregnancy rises appreciably to 61 per cent in the 110-114 mm range, a length which Beer and MacLeod state represents in either sex the adult animal. Embryo counts increased particularly in the larger voles. The average count was 4.4 for seven litters in the 90-109 mm classes, 4.9 for 43 litters in the 110-129 mm ranges and 7.0 for seven litters from the 130-149 mm size classes. The overall average size was 5.1 (one to eight embryos per litter).

Judged by testis size, maturity was reached a little earlier (80 mm) in the males than in the females and occurred in more than half the animals by the 110-114 mm size range. The position of the testis with respect to the scrotum is considered to be unreliable as a criterion of maturity since the testis may be withdrawn from the scrotum after the animal has been trapped.

In Table 1 the catches of July and October are compared. Differences in body lengths were not significant either between sexes or between months although there was an increase in the number of small females in October. Following Beer and MacLeod (1961) and taking 110 mm as adult size, the frequency of adult females was 45 per cent in July but 37 per cent in October, that of adult males 40 per cent in July and 38 per cent in October.

Characteristics of a High Population

In the third week of September 1957, a high population of voles was discovered three miles south of the village of Bayfield, close to the shore of Lake Huron, in Huron County. The area consisted of two small fields separated by a gravel road and swampy ground for a distance of 30 yards. Each was approximately three-quarters of an acre in size and covered with a mat of dense grass (chiefly *Poa pratensis* L.), with golden rod (*Solidago* spp.) and aster (*Aster* spp.) scattered throughout. With the assistance of undergraduate students of the Department of Zoology the fields were trapped simultaneously, one with snap and the other with live traps.

Snap-trap plot: This area was roughly rectangular with one boundary the road, and the other three made up of short mown grass of a camp area, a strip of mixed coniferous and hardwood bush along the lake, and a fence with brush along it separating the plot from a farmyard.

TABLE 1.—Comparison of voles caught in July and October.

	Females				Males			
	No.	Avge. body length, mm.	No. over 90 mm.	% preg.	No.	Avge. body length, mm.	No. over 80 mm.	% mature
July	117	105	101	48	101	102	91	56
Oct.	49	100	37	24	53	100	50	14

Victor snap traps were placed in a rectangular grid of eight lines with 15 stations to a line and two traps to a station. Since all lines and stations were five yards apart, the 240 traps covered an area of one-half acre, leaving a strip of approximately five yards remaining between the outer lines and the field boundaries. The traps were laid during an evening and examined at 8 a.m. and 8 p.m. for three days and one extra night. The bait used was a mixture of peanut butter and oatmeal; no serious weather disturbance occurred during the period.

The total catch is shown for each trapping period in Table 2. Along with *Microtus* were caught short-tailed shrews, *Blarina brevicauda*, white-footed mice, *Peromyscus leucopus noveboracensis*, and house mice, *Mus musculus*. Voles were caught throughout the plot at 65 of the 120 stations. Six shrews were taken in outside lines, five white-footed mice in the outer lines adjacent to the fence and strip of bush, one of the house mice in an outside line and the other two a short distance inside the grid.

The size of the population was estimated from the catch of the first three days to reduce the possible influence of migration into the plot. This did occur in period N4 when one of the marked voles from the live-trap plot 30 yards away was caught in a snap-trap. It is apparent from Table 2 that the catch fell off rather sharply after the second night. This, together with the fact that the small field was isolated to a certain extent by the nature of its boundaries, suggests that the number of 110 voles captured in the three days represents a large part of the population. If it is assumed then that the trap grid was taking animals up to the boundaries of the field (three-quarters of an acre), the population density would be around 140-150 voles per acre.

TABLE 2.—Total catch of small mammals with 240 snap traps. (N, D = Night, Day)

	N_1	D_1	N_2	D_2	N_3	D_3	N_4	Total
Microtus	45	22	26	5	9	3	8	118
Blarina	1	1	3	0	1	0	1	7
Peromyscus	2	0	2	0	0	0	2	6
Mus	1	0	1	0	1	0	0	3

TABLE 3.—Extent of damage by voles to trees in the live-trap plot.

Species	No. present	No. damaged
Red pine (*Pinus resinosa*)	38	9
Jack pine (*Pinus banksiana*)	32	0
Silver maple (*Acer saccharinum*)	37	32
Carolina poplar (*Populus canadensis*)	6	4
Willow (*Salix* sp.)	10	10
White elm (*Ulmus americana*)	2	2

Live-trap plot: This was also rectangular in shape, bounded by gravel roads on two adjacent sides and short mown grass on the remaining two sides. In addition to grass cover it contained a small plantation of trees about six years old. Many of these had been attacked previously by voles, and judging from the overgrowth around the scars this had occurred during the previous winter. All of the trees were alive for none had been girdled completely. In Table 3 is shown the number of trees present and the extent of the previous winter's damage. During the trapping period it was observed that several of the silver maples showed signs of fresh gnawing.

The live traps were tunnels of galvanized tin, 2 x 2 x 7 inches, with a tilting treadle supporting a spring-mounted door and the opposite end inserted into a small can provided with cotton wool. Forty traps were placed out the first evening, but this number was increased to 60 the next day when it was evident that the vole population was high. They were placed in a rectangular grid formation of six lines, 10 traps to a line, with lines and traps all 20 feet apart. The bait used was a mixture of peanut butter and oatmeal. The traps were laid in an evening and examined at 8 a.m. and 8 p.m. for the next four days. The captured voles were marked with numbered fingerling tags punched through either ear. After examination an animal was put down at least two feet away from the trap and made to run off in a direction away from the trap location.

In Table 4 appear some details of the daily catch. Temperature extremes may have contributed to the number of deaths for it fell below 50°F. on three nights and, except for partial cover in the heavy grass, the traps were not shielded from the sun during the day. The population estimates are calculated from the "Lincoln Index" method with the number of dead recaptures subtracted in each case. The average estimate of the last four trapping periods, D_2 to N_4, is 119, to which should be added the 19 dead for a total of 138 voles. One *Blarina* and three *Peromyscus leucopus* were caught, all but one of the latter in the outer traps.

The 62 recaptures of Table 4 involve 38 different animals and some idea of the mobility of this group may be gained from Table 5. It is apparent that 15 of the animals returned to the same trap as many as five times. The one captured six times alternated between two traps 28 feet apart; of the 12 caught three or more times only two made use of three traps and these were in line with one another. The calculation of the area over which an animal ranged

TABLE 4.—Daily catch of voles with 60 live traps (N, D = Night, Day)

	N_1*	D_1	N_2	D_2	N_3	D_3	N_4	Total
Total catch	22	23	28	23	29	19	24	168
Recaptures	0	2	5	11	17	10	17	62
No. dead	2	4	5	4	2	2	0	19
Population estimate	—	230	207	115	107	139	114	—

*40 traps only on first night

is not possible then because of this trapping pattern, and the range can be expressed only as the distance between the two farthest points of capture. In this case for the 38 voles the average maximum distance was 29.3 feet. According to the trapping record, 15 moved 0 feet; 17 moved between 20 and 50 feet; four between 60 and 90 feet; and the remaining two, 120 and 135 feet. Four of the six moving over 60 feet were males, but in the last night trapping period one marked female from this plot was caught in the snap-trap plot 200 feet distant.

The size of the home range of a single vole in normal populations has been reported to be as high as one-half acre (Blair, 1940), an area actually larger than the live-trap grid used here. However, if the recapture data are at all indicative of movement, range was much more restricted in the present study. In order to arrive at some estimation of density the effective area trapped was taken to be the trap grid (100 x 180 feet) plus a boundary strip of a width equal to half the average distance of movement. The effective area was then about 0.6 acres and the population density, using the average estimate of 138 voles on the plot, about 230 voles per acre. However close this estimate is, there was no doubt that the population was high. The ground was riddled with tunnels, the voles were seen continually moving about and some were even chased up trees.

During the trapping it appeared that the movements of the voles might be influenced by the surface features of the plot. The trees had been planted in furrows which had become filled with a dense mat of grass and riddled with runways. In comparing the amount of movement across with the amount

TABLE 5.—Frequency of capture and number of traps used by 38 voles.

	No. of voles caught				
Frequency of capture	2x	3x	4x	5x	6x
No. of traps used 1	10	3	1	1	0
No. of traps used 2	16	2	2	0	1
No. of traps used 3	0	1	0	1	0
Total	26	6	3	2	1

along the furrows it was found that among the 23 animals using two or three traps (Table 5) the difference was quite significant ($P<.01$) for 16 of them moved at least twice as many trap intervals along as across the furrows.

Measurements of the voles: In the live-trap plot some difficulty was experienced in sexing younger animals, but of 87 reliably identified, 34 were males and 53 females. In the snap-trap plot 93 voles were examined of which 41 were males and 52 females.

Physical measurements were made only of those taken with the snap traps. The body lengths of the females (70-140 mm) and the males (80-134 mm) fell into a size distribution similar to that of Figure 2. There were fewer small females under 90 mm, which raised the average body length to 107 mm, and 40 per cent of the females were adult (over 110 mm). The average body length of the males was 102 mm with 33 per cent adult.

The reproductive condition, however, was quite different from that found in the voles taken on the survey. Now in spite of similar or even larger average body sizes, only one female (132 mm) was pregnant (4 embryos) and 38 of the 41 males possessed testes 4 mm or less in length. There is even greater contrast here with the data of Beer and MacLeod (1961) who for 45 females taken in September report an average body length of 100 mm, 25 per cent adult and 38 per cent pregnant, and for 67 males an average length of 102 mm, 28 per cent adult but 54 per cent mature.

Discussion

It is difficult to generalize as to the distribution and relative density of *Microtus* in southwestern Ontario from such a trapping scheme which operated for only one year. For example, few mice were found in Simcoe county but damage has occurred in this area in the past. But it is also not clear that high numbers and damage always occur together. Judging from the survey, damage in the trapline area could not be predicted on the basis of the previous catch, and, while at Bayfield it was apparent that a high population was gnawing trees, it is still possible for a few mice working along furrows under the snow to do considerable harm.

The physical measurements of the voles agree with those given by Beer and MacLeod (1961) and others who show that there is usually a high proportion of young animals in these populations. But the reproductive characteristics of the high population at Bayfield were not consistent with those reported by the above authors who found up to half of their animals in breeding condition through the fall months. Rather they resembled the description of Spencer (1959) who states that late-season litters may not mature for four to six months; Cowan and Arsenault (1954) and Barbehenn (1955) make similar statements for species of *Microtus*. There is possibly a difference here between the reproductive conditions of high and low populations. In any case it is not clear why, when the voles continue to grow physically through the late summer, they do not come into breeding condition.

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A PLANT COLLECTION FROM SOUTHWEST NEWFOUNDLAND – JOHN BELL, 1867

ISABEL L. BAYLY
Carleton University, Ottawa, Ontario

THE NARRATIVE OF John Bell in *The Canadian Naturalist and Journal of Science* (Bell 1869, 1870) describes a schooner trip to the west coast of Newfoundland in the summer of 1867. The narrative contains daily lists of the plants which he saw or collected. Several authors referred to Bell's papers, particularly Fernald (1911), and John Macoun (1883-1888) who made many references to John Bell in his *Catalogue of Canadian Plants*, which included, whenever possible, Newfoundland distributions. Macoun (1883) stated in the preface to his *Catalogue*, ". . . for our notices of Newfoundland plants . . . we are indebted to the late Dr. John Bell, who published a list of plants collected by him on the west coast of that island in the summer of 1867". After leading a collecting expedition to western Newfoundland in the summer of 1910, Fernald (1911) expressed doubts about the identifications of some species in Bell's collection. ("Dr. John Bell noted some of the commonest plants, with a few which are certainly rare or local on the island – *Claytonia caroliniana* from a mountain side south of the Great Cod Roy River; *Dryopteris fragrans* from Cairn Mountain;

Epilobium latifolium from Flat Bay Brook and Grand Lake – and several which were surely misidentified. Dr. Bell's *Vallisneria spiralis* which the waves rolled in quantities on the beach of Bay St. George was certainly *Zostera marina*, his *Viburnum Lentago* must have been the common *V. cassinoides*, his *Cirsium pumilum* from "The Gravels" was undoubtedly a form of *C. muticum*, his *Aspidium marginale* from the Bay of Islands was unquestionably the there common *A. Filix-mas*; and there is grave doubt of the occurrence in Newfoundland of such plants as *Asplenium thelypteroides*, *Salix petiolaris*, *Betula lenta*, *Thalictrum dioicum*, *Lonicera oblongifolia* and *Viburnum acerifolium*.") Although the papers have been quoted by these authors, apparently Bell's collections had not been seen by either of them, nor did any of his Newfoundland specimens turn up in a recent search of herbaria.

In the summer of 1959 a pair of plant presses, ascribed to Robert Bell, eminent Canadian geologist, and sometime director of the Geological Survey of Canada, were presented to Carleton University by his daughter, Mrs. Olga Bell Outram. They proved to be collections made by John Bell, brother of Robert. One collection was from Newfoundland, the other from Manitoulin Island, Canada West.

The presses are of the type now described as "Forest Ranger" – two strong solid boards fastened with cross braces and bound with leather straps. The papers enfolding the specimens are from editions of the *Toronto Globe* between 1864 and 1867.

The sparse collection data, consisting only of dates and collecting areas written on slips of paper signed "John Bell, M.A., M.D." are less sophisticated than those recorded nowadays. For instance, the inscription "Grand Cod Roy River, July 13, 1867" indicates only a general area. The collecting area most readily identified is "The Gravel", an area of high gravel cliffs about one mile in length which is adjacent to the town of Port au Port, and which extends along the shore connecting a large part of western Newfoundland with the mainland.

The data slips with the actual collection indicate that Bell's plants came from the following collecting areas: Great Cod Roy River; "The Gravel" (St. Georges Bay); South Arm, Bay of Islands; Long Point, Port au Port Bay; Flat Bay Brook, St. Georges Bay; West Bay in Port au Port; Port au Port Bay; Deer Lake; Humber River; Fork, Humber River; Cod Roy Island; Flat Bay. The locations of these geographical features are shown in Figure 1.

In the fall of 1963 an extensive supplement to the John Bell Collection was received by Carleton University under the terms of the will of Mrs. Olga Bell Outram. It contained 38 mounted Newfoundland specimens from "The Gravel", Cairn Mountain, Flat Bay Brook and the north fork of the Humber River. Their order shows that John Bell had begun to mount up the more worthy specimens of the Newfoundland collection for preservation in his private herbarium. This activity was never completed, but the press contents, together with the mounted sheets, seem to represent the complete collection.

Bell's method of collection, which involved very limited press space, did not follow the practice of one species to a sheet, and ten or twelve species may be present in a tangled mass. It was assumed that all specimens on one sheet were

FIGURE 1. Map of southwestern Newfoundland, showing collecting sites of John Bell. (Some rivers are slightly exaggerated in size.)

gathered from the same area on the same day. Owing to insect, fungus and water damage, many of the plants are fragmentary. Some species are represented by a few leaves; some of the ferns lack sporangia and rhizomes. The list contains more species than did Bell's papers, since he did not mention such "trivia" as the Carices or the Gramineae, groups which he apparently considered would be of little interest to the readers.

The nomenclature and order of the following list of vascular plants in the John Bell Collection follows that found in Gleason (1958). Species not listed therein are found in Polunin (1959). Dr. E. Rouleau has seen the collection

and verified my identifications. The numbers which follow the locality are not Bell's numbers, but have been arbitrarily assigned. They represent the order in which the specimens appeared in the press. Omitted numbers represent lichens and mosses.

ANNOTATED LIST OF SPECIES

*Indicates that a collecting label accompanied the specimen. The information on the collecting label is quoted. Other locality information is based on the papers of John Bell (1869, 1870).

Lycopodium annotinum L.—St. Georges Bay, 132; *Lycopodium lucidulum* Cairn Mountain*. Macoun lists Bell's *L. lucidulum* as the only Newfoundland collection. There is no *Lycopodium lucidulum* in the Bell Collection.

Lycopodium sitchense Rupr.—South Arm, Bay of Islands, 114; St. Georges Bay, 159A; *Lycopodium alpinum*, Cairn Mountain*: Bell lists *L. alpinum* in his paper, so these specimens are probably the species he has mistaken for *L. alpinum*.

Lycopodium complanatum L.—St. Georges Bay, 159B.

Lycopodium tristachyum Pursh.—Near Cairn Mountain*. This sheet is labeled "*Lycopodium complanatum*".

Equisetum sylvaticum L.—St. Georges Bay, 136. Bell mentions a "deciduous *Equisetum* collected on an island of Deer Lake".

Athyrium Filix-femina (L.) Roth.—Southwest Newfoundland, 46. Bell mentions *Asplenium filix-femina*, collected "12 miles from the mouth of the Great Cod Roy River, in rich damp woods", July 6, 1867.

Woodsia alpina (Bolton) S. F. Gray—St. Georges Bay, 106. Bell lists *Woodsia ilvensis*, collected on a rocky escarpment, Flat Bay Brook, June 18.

Thelypteris novaboracensis (L.) Nieuwl.—Great Cod Roy River, July 7, 1867, J. Bell, 73*. Bell lists this fern. The specimen in the collection lacks sporangia and rhizome.

Dryopteris fragrans (L.) Schott.—Cairn Mountain, 87*. Fernald mentioned that this fern must be local or rare. Macoun did not cite Bell's reference to *Aspidium fragrans*.

Dryopteris Filix-mas (L.) Schott.—*Marginale*, South Arm, Bay of Islands, Nfld. 74*. This plant is listed as *Aspidium marginale*. Fernald suggested that it was probably "Male Fern". One of the mounted sheets, labeled "South Arm, Bay of Islands, *Aspidium spinulosum* var. *Bootii*" represents a second misidentification.

Polystichum Braunii (Spenner) Fée—"The Gravel", St. Georges Bay, July 4, 71*; Great Cod Roy River, July 8, 72*. Bell listed this fern for "The Gravel" only, where it grew above the cliffs.

Juniperus horizontalis Moench.—"The Gravel" July 4, 165*.

Potamogeton epihydrus Raf.—Great Cod Roy River, Nfd., July 8, 225, 331*.

Potamogeton Friesii Rupr.—Great Cod Roy River, July 8, 287*.

Triglochin maritima L.—Great Cod Roy River, 171, 175.

Triglochin palustris L.—Southwest Nfld., 62.

Festuca rubra L.—Great Cod Roy River, 170; Flat Bay Brook, St. Georges Bay, 203; "The Gravel", St. Georges Bay, 253; Southwest Nfld., 28.

Glyceria canadensis (Michx.) Trin.—Great Cod Roy River, Nfld., July 8, 327*.

Poa palustris L.—Southwest Nfld., 54.

Elymus virginicus L.—Southwest Nfld., 45.

Elymus mollis Trin.—Great Cod Roy River Nfld., July 8, 321*.

Trisetum spicatum (L.) Richter.— Southwest Nfld., July 8, 51, 53.

Agrostideae—St. Georges Bay, 162.

Calamagrostis canadensis (Michx.) Beauv.—Southwest Nfld., 10, 30.

Agrostis tenuis Sibth.—Great Cod Roy River, 261; Southwest Nfld., 61.

Agrostis sp.—Great Cod Roy River, 269.

Milium effusum L.—Great Cod Roy River, 176.

Hierochloe odorata (L.) Beauv.—Flat Bay Brook, St. Georges Bay, 190.

Eleocharis halophila Fern & Brackett—Great Cod Roy River, 239.

Eleocharis parvula (R. & S.) Link.—Great Cod Roy River, Newfoundland, July 6, 260*.

Eleocharis palustris (L.) R. & S.—Great Cod Roy River, 272.

Scirpus cespitosus L.—St. Georges Bay, 157; Great Cod Roy River, 297.

Scirpus hudsonianus (Michx.) Fern.—Great Cod Roy River, 345.

Scirpus validus Vahl.—St. Georges Bay, 195. Bell lists *S. lacustris*, a European species, for Long Point. This is the only *Scirpus* named in the papers.

Scirpus rufus (Huds.) Schrader.—Southwest Nfld., 56, 63.

Scirpus atrovirens Willd.—Great Cod Roy River, 262.

Eriophorum opacum (Björnstr.) Fern.—St. Georges Bay, 156; Flat Bay*.

Eriophorum viridi-carinatum (Engelm.) Fern.—St. Georges Bay, June 27, 122*; Flat Bay Brook*.

Eriophorum angustifolium Honckeny.—St. Georges Bay, 135; Great Cod Roy River, 224.

Eriophorum vaginatum L.—Flat Bay Brook*.

Eriophorum Chamissonis C. A. Mey.—"*vaginatum*" Flat Bay*.

Eriophorum tenellum Nutt.—Flat Bay*.

Carex sp.—Long Point, Port au Port Bay, 188.

Carex cephalantha (Bailey) Bickn.—Long Point, Port au Port Bay, 233; Great Cod Roy River, 241.

Carex stipata Muhl.—South Arm, Bay of Islands, 105; "The Gravel", St. Georges Bay, 258; Great Cod Roy River, 164.

Carex Mackenziei Krecz.—Southwest Nfld., 19.

Carex interior Bailey.—Great Cod Roy River, Nfld., July 7, 268*, 163, 169, 346; Long Point, 187.

Carex leptonervia Fern.—Great Cod Roy River, 320; "The Gravel", St. Georges Bay, 259.

Carex scoparia Schk.—Great Cod Roy River, 319.

Carex scirpoidea Michx.—Great Cod Roy River, 288.

Carex aurea Nutt.—"The Gravel", St. Georges Bay, 256. This is the only species of *Carex* which Bell actually mentioned.

Carex arctata Boott.—South Arm, Bay of Islands, 103.

Carex capillaris L. var. *elongata* Olney—Great Cod Roy River, 302.

Carex flava L.—Great Cod Roy River, 172, 238.

Carex viridula Michx—Great Cod Roy River, 161, 244, 263; Flat Bay Brook, St. Georges Bay, 193.

Carex rariflora (Wahl.) Smith.—Southwest Nfld., 16; Cod Roy Island, 276.

Carex salina Wahl.—South Arm, Bay of Islands, 104; Long Point, Port au Port Bay, 234; Great Cod Roy River, 273.

Carex lenticularis Michx.—Great Cod Roy River, 231, 245.

Carex paleacea Wahl.—Flat Bay Brook, St. Georges Bay, 194.

Carex crinita Lam.—Great Cod Roy River, 344; Cod Roy Island, 324.

Carex lacustris Willd.—Great Cod Roy River, 264.

Carex lasiocarpa Ehrh.—Great Cod Roy River, 168.

Carex rostrata Stokes—Great Cod Roy River, 165.

Carex intumescens Rudge.—Great Cod Roy River, 267.

Juncus balticus Willd.—Southwest Nfld., 48; Flat Bay Brook, St. Georges Bay, 202; South Arm, Bay of Islands, 80.

Juncus bufonius L. var. *halophilus* Fern. & Buch.—Southwest Nfld., 22.

Juncus trifidus L.—Great Cod Roy River, 300. Note: Only one species, *J. effusus*, listed for Long Point, is mentioned by Bell.

Luzula campestris (L.) DC.—Great Cod Roy River, 316; Cod Roy Island, 277; Long Point, Port au Port Bay, 232.

Tofieldia glutinosa (Michx.) Pers.—Great Cod Roy River, 237.

Smilacina stellata (L.) Desf.—Flat Bay Brook, 250.

Smilacina trifolia (L.) Desf.—Flat Bay Brook, 173.

Trillium cernuum L.—South Arm, Bay of Islands, 78, 101. *T. recurvatum* is listed for Flat Bay Brook.

Iris versicolor L.—Flat Bay Brook, St. Georges Bay, 199.

Cypripedium Calceolus L.—Great Cod Roy River, July 8, 214, 330*.

Habenaria hyperborea (L.) R. Br.—255.

Habenaria viridis (L.) R. Br.—Great Cod Roy River, 301.

Habenaria dilatata (Pursh) Hook.—Great Cod Roy River, 303.

Habenaria obtusata (Pursh) Richards.—South Arm, Bay of Islands, 76; Great Cod Roy River (Ryan's), 332.

Arethusa bulbosa L.—Near Cairn Mountain, Flat Bay Brook*; South Arm Bay of Islands, 77.

Spiranthes Romanzoffiana Cham.—Southwest Nfld., 60.

Corallorhiza trifida Chat.—Great Cod Roy River, 304. Bell listed *C. multiflora,* found in "rich damp woods, 12 miles from the mouth" of the Great Cod Roy River.

Salix glaucophylloides Fern.—Great Cod Roy River, 236.

Salix Uva-ursi Pursh.—Great Cod Roy River, 305, 306; alpine summits Cod Roy Mountains*.

Salix pellita Anderss.—Humber River, 211; St. Georges Bay, 139.

Salix Bebbiana × *candida* ?—"The Gravel", 252. Bell has this specimen listed as *Salix humilis.*

Betula lutea Michx.—St. Georges Bay, 158. Bell lists *B. excelsa* for Flat Bay Brook.

Betula pumila L.—St. Georges Bay, 131.

Betula glandulosa Michx.—sphagnum marsh near Cairn Mt. Nfld.*

Betula Michauxii Spach.—St. Georges Bay (Flat Bay Brook), 127, 140.

Alnus crispa (Ait.) Pursh.—St. Georges Bay, 130, 196.

(*Castanea dentata* (Marsh.) Borkh.—see discussion, 7.)

Urtica urens L.—South Arm, Bay of Islands, 75.

Comandra livida Richards.—Southwest Nfld., 25, 33, 68.

Polygonum viviparum L.—Flat Bay Brook, St. Georges Bay, 204; Long Point, Port au Port Bay, 185.

Polygonum lapathifolium L.—Southwest Nfld., 58.

(*Polygonum virginianum* L.—See discussion, 11.)

Chenopodium album L.—Southwest Nfld., 66.

(*Phytolacca americana* L.—See discussion, 3.)

Montia fontana L.—Southwest Nfld., 37. Bell has listed *Claytonia caroliniana* and Fernald has suggested that it must have been rare or local in Newfoundland. The genus *Claytonia* is not present in Bell's collection. *Montia* is represented by this single collection.

Stellaria longipes Goldie.—Southwest Nfld., 17; Great Cod Roy River, 318.

Stellaria calycantha (Ledeb.) Bongard—Southwest Nfld., 43, 47.

Stellaria crassifolia Ehrh.—Southwest Nfld., 44.

Arenaria lateriflora L.—Southwest Nfld., 64.

Sagina nodosa (L.) Fenzl.—South Arm, Bay of Islands, 79; North shore*.

Honkenya peploides (L.) Ehrh.—Southwest Nfld., 67; Flat Bay (in St. Georges Bay), June 30, 285*; Port au Port Bay, July 24, 207*.

Nuphar advena Ait.—N. Fork, Humber R., Newfoundland*. Macoun lists J. Bell as the first collection of this species on the west coast of Newfoundland.

Thalictrum alpinum L.—South Arm, Bay of Islands, 102. *T. cornuti,* and *T. dioicum* are both listed by J. Bell. Fernald has questioned the presence of *T. dioicum.* The collection does not support Bell's paper.

Ranunculus Cymbalaria Pursh.—Flat Bay Brook, 191; Great Cod Roy River, 348. Bell listed *R. repens* for a "boggy rill" near Ryan's on the Great Cod Roy River.

Ranunculus pennsylvanicus L.—Great Cod Roy River, 271. This has the same collecting location as *R. repens.*

Cakile edentula (Bigel.) Hook.—Flat Bay, 286.

(*Draba arabisans* Michx.—See discussion, 1, 14.)

(*Cochlearia tridactylites* Banks.—See discussion, 4, 29.)

Cardamine pennsylvanica Muhl.—Port au Port Bay, 206. Bell listed *C. birsuta* for Long Point, Port au Port Bay.

Drosera intermedia Hayne.—South Arm, Bay of Islands, 119; St. Georges Bay, 133.

Sedum Rosea (L.) Scop.—Flat Bay Brook, 31.

Saxifraga aizoides L.—"The Gravel", St. Georges Bay, 251.

Mitella nuda L.—Flat Bay Brook, 109.

Ribes hirtellum Michx.—St. Georges Bay, 123, 146; Flat Bay Brook, St. Georges Bay, 198.

Ribes lacustre (Pers.) Poir.—St. Georges Bay (Ryan's), 143.

Ribes triste Pall.—Great Cod Roy Island, 326.

Ribes glandulosum Grauer.—St. Georges Bay, 115, 129.

(*Liquidambar Styraciflua* L.—See discussion, 6.)

(*Potentilla palustris* L. Scop.—See discussion, 13. *P. fruticosa* listed for Flat Bay Brook.)

Potentilla tridentata Soland.—Southwest Nfld., 65; South Arm, Bay of Islands, 98; Great Cod Roy Island, 278, 323.

Geum macrophyllum Willd.—Great Cod Roy River, Nfld., July 8, 242*.

Rubus pubescens Raf.—Flat Bay Harbour, 178.

Rubus Chamaemorus L.—Long Point, Port au Port Bay, 184; Great Cod Roy River, 274.

Sanguisorba canadensis L.—Southwest Nfld., 34.

Rosa sp.—label reads Rosa blanda? Ait.—N. shore*. Sheet has eglandular stipules and fruit, coarsely toothed leaflets. Specimen lacks flowers.

Rosa virginiana Mill.—Southwest Nfld., 41, 50.

Rosa nitida Willd.—St. Georges Bay, 126.

Pyrus floribunda Lindl.—South Arm, Bay of Islands, 81, 94.

Pyrus decora (Sarg.) Hyland.—Flat Bay Brook, 200.

Amelanchier Bartramiana (Tausch). Roemer.—St. Georges Bay, 141, 148.

Crataegus Brunetiana Sarg.—Fork, Humber River, 212. Bell has listed *C. coccinea* in his paper: Macoun has noted this in the Catalogue (Vol. 1, p. 147).

(*Trifolium agrarium* L.—See discussion, 9.)

Hedysarum alpinum L.—Great Cod Roy River, 235, 240.

Vicia Cracca L.—Southwest Nfld., 23.

Lathyrus maritimus (L.) Bigel. var. *pellitus* (Fern.) Gl.—Cod Roy Island, Nfld., July 13, 281*. Bell has listed a "variety of beach pea" for Cod Roy Island.

Empetrum nigrum L.—St. Georges Bay, 150; Cod Roy Island, 279; Cairn Mountain, Nfld.*.

Nemopanthus mucronatus (L.) Trel.—South Arm, Bay of Islands, 107; St. Georges Bay, 153; Deer Lake 209.

Triadenum virginicum (L.) Raf.—Great Cod Roy River, 243. This species is represented by leaf fragments only.

(*Lythrum Salicaria* L.—See discussion, 8, 12.)

Epilobium latifolium L.—Flat Bay Brook, 189; Great Cod Roy River (?) 249; shingle, Flat Bay Brook*. Fernald (1911) suggested that *E. latifolium* must be very rare or local.

Epilobium palustre L.—Great Cod Roy River, 347.

Oenothera biennis L.—Southwest Nfld., 69.

Aralia hispida Vent.—Label reads only "*Aralia hispida* Michx.—Bristly Sarsaparilla".

Conioselinum chinense (L.) BSP—Great Cod Roy River, 328.

Angelica atropurpurea L.—Great Cod Roy River, July, 1867, 329*.

Cornus canadensis L.—Great Cod Roy River, 309.

Cornus suecica L.—Southwest Nfld., 18, 49; Long Point, 183; Port au Port Bay*; Great Cod Roy Isd., July 18, 322*.

Moneses uniflora (L.) Gray.—Great Cod Roy River, 221.

Pyrola asarifolia Michx.—St. Georges Bay, 160. Bell has listed *P. rotundifolia*, Flat Bay Brook area.

Pyrola elliptica Nutt.—Deer Lake, Nfld., July 17, 1867, 208*.

Pyrola secunda L.—Great Cod Roy River, 222.

Rhododendron canadense (L.) BSP.—St. Georges Bay, 145, 147; Cairn Mountain*, Flat Bay, Nfld.*.

Loiseleuria procumbens (L.) Desv.—Flat Bay Brook, St. Georges Bay, 82, 93, 99, 111, 118, 120; Cairn Mountain, Nfld.*.

Kalmia polifolia Wang.—St. Georges Bay, 124.

Kalmia angustifolia L.—St. Georges Bay, 152.

Andromeda glaucophylla Link.—St. Georges Bay, 154; sphagnum bog near Flat Bay, Nfld.*.

Chamaedaphne calyculata (L.) Moench—St. Georges Bay, 155; heath, near Cairn Mountain, Nfld.*.

Arctostaphylos alpina (L.) Spreng.—Great Cod Roy River, 223, 230, 290, 307; Flat Bay, Cairn Mountain*. Bell has listed *A. Uva-ursi* for Cairn Mountain.

Vaccinium uliginosum L.—St. Georges Bay, 96, 119, 112, 113; Great Cod Roy River, 308; Cairn Mountain, Nfld.*.

Vaccinium Vitis-Idaea L.—Southwest Nfld. (Flat Bay Shore), 40, 70; St. Georges Bay, 97; Cairn Mountain*.

Vaccinium angustifolium Ait.—St. Georges Bay (Flat Bay Brook), 116, 128; Great Cod Roy River, 311.

Vaccinium Oxycoccos L.—Southwest Nfld., 21; St. Georges Bay, 90; Great Cod Roy River, 166, 174.

Diapensia lapponica L.—Great Cod Roy River, July 8, 1867, 289, 298, 337*; Flat Bay Brook (Cairn Mountain)*.

Primula mistassinica Michx.—St. Georges Bay, 108.

Primula laurentiana Fern.—Long Point, 179; Flat Bay Brook, St. Georges Bay, 205*.

Gentiana nesophila Holm—Long Point, Port au Port Bay, 182, 186.

Menyanthes trifoliata L.—Southwest Nfld., 32; St. Georges Bay, 134; ponds in sphagnum bog or heath near Cairn Mountain*.

Mertensia maritima (L.) S. F. Gray—Southwest Nfld., 42; Flat Bay (in St. Georges Bay) June 30, 283*.

Scutellaria galericulata L.—Great Cod Roy River, 257, 270.

Euphrasia Randii Robins.—Long Point, Port au Port Bay, 181.

Melampyrum lineare Desr.—Southwest Nfld., 26.

Castilleja septentrionalis Lindl.—Humber River, July 17, 210*.

(*Campsis radicans* (L.) Seem.—See discussion, 5.)

Orobanche uniflora L.—St. Georges Bay, 137; woods near Cairn Mountain, Nfld.*.

Pinguicula vulgaris L.—St. Georges Bay, 100; Flat Bay Brook, Nfld.*.

Plantago maritima L.—Long Point, Port au Port Bay, July 12, 180*; St. Georges Bay, 254; Flat Bay (in St. Georges Bay), June 30, 284*.

Galium kamschaticum Steller.—Great Cod Roy River, 226.

Galium asprellum Michx.—Great Cod Roy River, July 7, 1867, 266*.

Galium palustre L.—Great Cod Roy River, 167.

(*Galium labradoricum* (Wieg.) Wieg.—See discussion, 2.)

Viburnum cassinoides L.—St. Georges Bay, 151. Bell has identified this plant as *V. Lentago*. Fernald has suggested a misidentification.

Viburnum opulus L. var. *americanum* Ait.—Fork, Humber River, July 18, 1867, 213*; *Viburnum Opulus* L.—island, N. Fork Humber River*.

Viburnum edule (Michx.) Raf.— Southwest Nfld., 24*. *Viburnum pauciflorum*—N. shore*. The presence of a sheet identified by Bell as *V. pauciflorum* does little to clear Fernald's contention that Bell could not have seen *V. acerifolium* in Newfoundland. Bell has listed both species. Neither authors give authority names. *Viburnum acerifolium* L. is not contained in the collection. *V. pauciflorum* Pylaie and *V. acerifolium* Bong. are both names which are no longer in use for *V. edule* (Michx.) Raf.

Lonicera villosa (Michx.) R. & S.—St. Georges Bay, 125, 144, 149; Great Cod Roy River, July 8, 1867, 177, 310*, 317*. Bell has listed *L. oblongifolia*. Fernald doubted the identification.

Solidago macrophylla Pursh.—Southwest Nfld., 39.

Aster umbellatus Mill.—Southwest Nfld., 20, 55.

Achilea Millefolium L.—Southwest Nfld., 52.

Leontodon autumnalis L.—Cod Roy Island, July 13, 1867, 275*, 280, 282.

Prenanthes racemosa Michx.—Southwest Nfld., 36.

Hieracium kalmii L.—Southwest Nfld., 35.

DISCUSSION

Present status of John Bell's collecting localities

As far as possible the collecting sites were checked during the summer of 1960 and 1962. The flora of the area of Flat Bay Brook village is much the same, as is that of Flat Bay Brook itself (Figure 2), which is now a scheduled salmon river. A bush road described by Bell is there, but now is overgrown, and the gravel beds in the stream where he collected *Epilobium latifolium* still support that species. The Trans-Canada highway crosses Flat Bay Brook about four miles above its mouth and there are some disturbances associated with road building. A few white pines mentioned by Bell but not authenticated by the collection still grow on the shores. "The Gravel", Bell's collecting area at Port au Port, is readily identified. It has a sheltered harbour and a one mile stretch of gravel beach and cliff. Unspoiled in Bell's time, the trees and ferns on the top are now gone, through storms, farming, introduction of a road cut and use of part of the area as a garbage dump. Despite this, *Shepherdia*,

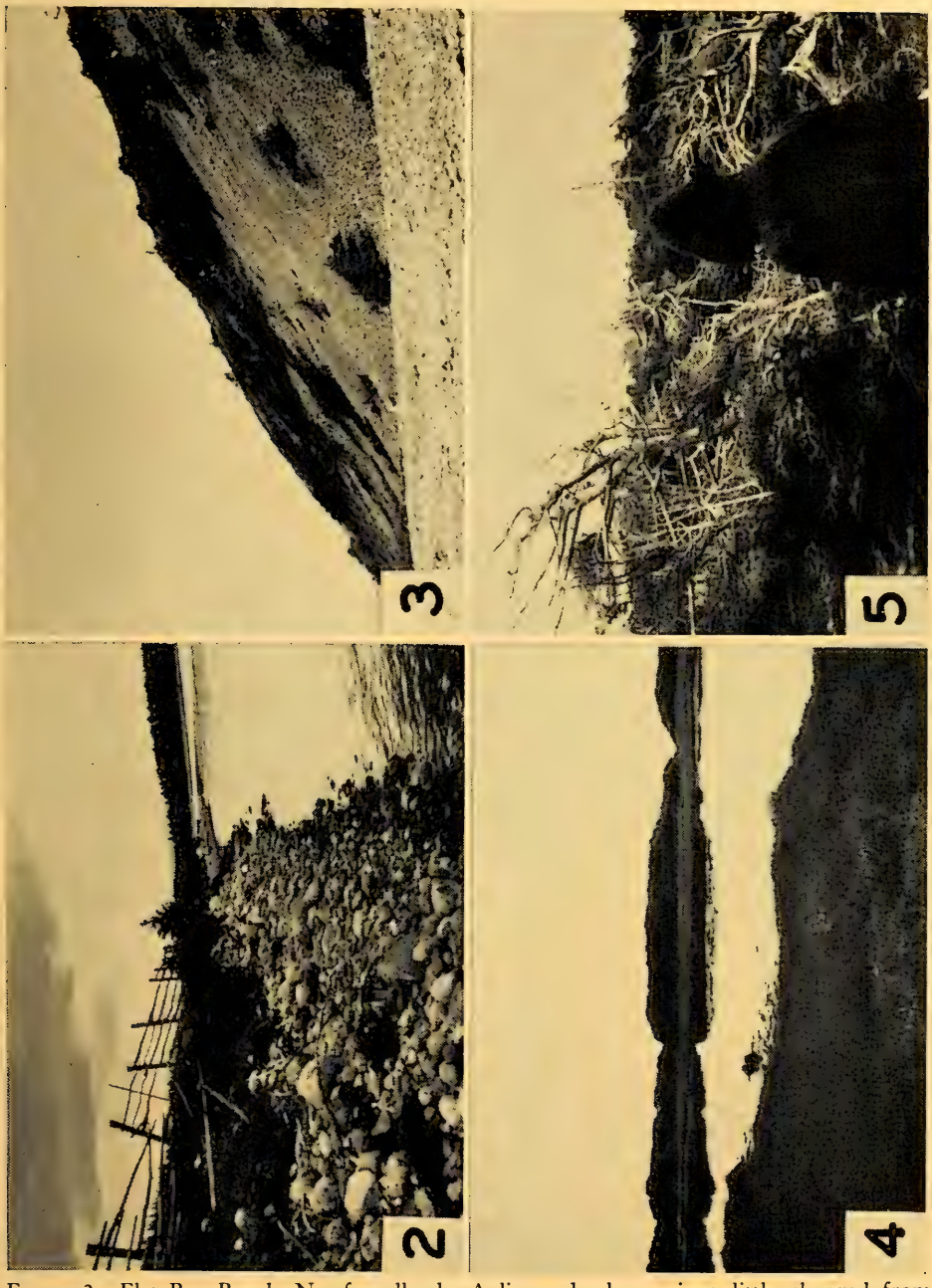

FIGURE 2. Flat Bay Brook, Newfoundland. A licensed salmon river, little changed from the time of John Bell. Water here is saline, shores support *Mertensia maritima* and *Cakile edentula*. July, 1960.

FIGURE 3. "The Gravel", Port au Port. Expansion of town dump, and road building, have changed the flora on top of the cliffs, but cliff itself still supports *Shepherdia*, *Carex aurea*, dwarf juniper. July, 1960.

FIGURE 4. Boggy meadow, Long Point, Newfoundland, described by Bell. Unchanged except for overgrazing on nearby hill. July, 1960.

FIGURE 5. Dwarfed spruce, Long Point, Newfoundland. Note heavy incidence of witches' brooms. July, 1960.

Oenothera, *Rhinanthus*, *Antennaria* and *Carex aurea* still hold the crumbling gravel together (Figure 3). The Grand Cod Roy River, a scheduled salmon stream, has minimum farming and is roughly the same as when Bell travelled there. A stream which has the name of Ryan's Brook indicates his collecting location for the "profusion of garden flowers and weeds" which he mentioned. From Cod Roy, Bell's schooner sailed up the coast to Long Point, a narrow sliver of land which separates the Gulf of St. Lawrence from Port au Port Bay. This area is heavily overgrazed, because local residents use the point as a community sheep pasture. The boggy meadow mentioned by Bell was located (Figure 4). It contains a quaking bog which supports *Toffieldia*, *Habenaria* and the typical members of the sphagnum bog community, although it is only about 20 feet from the sea itself. The close cropping by the sheep on Long Point has left little of the original flora except the dwarf spruces (Figure 5) and the bogs. The region of the Humber Arm, or as Bell says, the south arm of the Bay of Islands, has been used by a pulp and paper company as a flotation basin for pulp logs and there has been extensive cutting of timber. Deer Lake also fills with pulp logs, and farmlands occupy parts of the shore of Deer Lake. At the mouth of the Humber River, which is described by Bell as choked with eel grass, the water is now filled bank to bank with floating pulp logs. There is a point of land just before the mouth of the river on which Bell camped and collected. Along this strand, close to the town of Deer Lake, grow two species of maple (*spicatum* and *rubrum*) as Bell said. These are old trees, many-suckered from their parental root stocks. It is possible that these are descendants of the originals which Bell mentioned (but did not collect). The areas above Deer Lake visited by Bell are now timber limits, and cutting and forest fires have changed the original collecting site.

Present status of the Newfoundland collection of John Bell

When Dr. John Bell published his Newfoundland papers he assumed that his readers would enjoy an account of the trip, and since he was an enthusiastic member of the Canadian Botanical Society he included as many plants with Latin nomenclature as possible. The insertion of such names was necessarily limited. The nomenclature was only as accurate as Bell's experience allowed, since nobody except perhaps Robert Bell ever saw the collection. That Macoun and Fernald placed such emphasis on his list of plants seems good reason for a re-listing of this important, though obscure, collection.

The contents of the press, additional mounted sheets and John Bell's two papers form the basis of this discussion. They help to answer the questions of Fernald and Macoun concerning the doubtful presence of some species and the misidentification of others. In turn, they present additional problems. These are misidentifications which have gone unchallenged and presence of anomalous species which appear at the front of the press.

Fernald has questioned the presence of the following plants: *Asplenium thelypteroides*, *Salix petiolaris*, *Betula lenta*, *Thalictrum dioicum*, *Lonicera oblongifolia* and *Viburnum acerifolium*. None of these plants is represented in the collection. The listing of *Asplenium thelypteroides* may have been a

sight misidentification of a young plant of *Thelypteris noveboracensis* (L.) Nieuwl. *Salix pellita* Anderss. is the closest representative of that genus. The *Betula lenta* listing by John Bell was a sight record made at the "bend of the river" (Flat Bay Brook) below Cairn Mountain. The plant may have been *Betula lutea* forma *fallax* Fassett. The only *Thalictrum* in the collection is *T. alpinum* L. *Lonicera villosa* (Michx.) R. & S. holds the collecting label "Great Cod Roy River, July 8, 1867", the collecting station for the plant Bell identified as *Lonicera oblongifolia.* The problem of *Viburnum acerifolium* is complicated by Fernald's omission of authority name. The collection does not contain *Viburnum acerifolium* L., but *Viburnum edule* (Michx.) Raf. which in former times has been named *Viburnum acerifolium* Bong. or *V. pauciflorum* Pylaie is present. Macoun did not make use of Bell's listing of *V. acerifolium* for Newfoundland, and said of such records "This species is reported from Newfoundland . . . but, as it was formerly confounded with the next (*V. pauciflorum* Pylaie) I believe these references belong with the next."

In addition to the problem of the distribution of certain species, Fernald also challenged parts of the Bell listing as misidentifications. These species identifications were: *Vallisneria spiralis* which Fernald assumed was *Zostera marina; Viburnum Lentago* which Fernald suggested was *V. cassinoides; Cirsium pumilum* considered to be *C. muticum; Aspidium marginale* which Fernald believed to be "the there common *Aspidium Filix-mas*". Neither *Vallisneria* nor *Zostera* are among the plants in the collection. This sight record "on the coastal shoreline at Flat Bay village" would certainly add support to the view of Fernald that the plants that Bell saw were *Zostera marina* L. *Viburnum cassinoides* L. is in the collection. There is no representative of the genus *Cirsium.* A fern which recently turned up in the mounted specimens bears the label "*marginale* South Arm, Bay of Islands, Nfld." is, as Fernald suggested, a specimen of "Male fern" (now *Dryopteris Filix-mas* (L.) Schott.).

Plants which Fernald considered rare or local in the Bell listing were: *Claytonia caroliniana, Aspidium fragrans* and *Epilobium latifolium.* The collection does not contain the genus *Claytonia* but does contain *Montia fontana* L., a close relative. The specimen has flower buds and well-developed leaves. Present in the collection is *Dryopteris fragrans* (L.) Schott (collecting label "Cairn Mountain"). One of the sheets of *Epilobium latifolium* L. bears the label "shingle, Flat Bay Brook".

Macoun made extensive use of the Bell plants in his Catalogue. Of 143 John Bell records cited, 15 are from the west coast of Newfoundland. One is not listed in the papers, nor is it present in the collection (*Ranunculus acris* L.), two are sight records (*Acer saccharinum* Wang., *Myriophyllum spicatum* L.), one is listed but is not in the collection (*Aralia nudicaulis* L.), several are misidentified (*Sagina procumbens* L., *Crataegus coccinea* L., *Lycopodium lucidulum* Michx., *Lycopodium obscurum* L.) and the remainder (including *Nuphar advena* Ait., *Sanguisorba canadensis* L., *Saxifraga aizoides* L., *Angelica atropurpureum* L. and several species of *Lycopodium*) are present and correctly identified.

A final problem arises from the presence in the plant press of a set of plants (my numbers 1-15) which do not appear to be from Newfoundland.

The distribution of some (*Castanea, Liquidambar, Campsis radicans*) is more southerly. Others, like *Draba arabisans* Michx. and *Trifolium procumbens* L. are of very wide distribution on the eastern coast of North America. All lack collecting labels. At first, the only immediate explanation for these plants was that they represented the cultivated flowers from the Ryan's Brook area or from Flat Bay Brook village. Considering the wealth of detail which Dr. John Bell wrote in his papers, it is unlikely that he would overlook such items as *Castanea* or *Lythrum Salicaria.* It seems doubtful that the first numbers in the press are from the west coast of Newfoundland. The only other explanation is that John Bell had inserted a small collection from some other source in the top of the press. When he began to mount up the press contents, he would first select from the press the more interesting items, leaving most of the anomalous specimens still on the top of the press. The mounted sheets contained labelled specimens from Newfoundland plus one *Lygodium palmatum* (Bernh.) Sev. This fern lay on a herbarium sheet, but had not been affixed to it. The collecting label reads "Miss Isabella McIntosh, Northampton, Vt. U.S.". It is possible that the other problem species may have the same source.

This collection, made by a young medical doctor in the year of Confederation, helped to increase the knowledge of the flora of Newfoundland. John Bell was not the first to collect on the island, but his papers, so carefully written and free from ambiguity, are useful to all who have an interest in the distribution of vascular plants in Newfoundland. The extent of the collection, exclusive of the Bryophytes, is embodied in this paper. The collection is now housed in the Carleton University herbarium.

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REVIEWS

Birds of the Labrador Peninsula and Adjacent Areas

By W. E. Clyde Todd. 1963. University of Toronto Press, Toronto. 819 pp. $18.00.

In size, scope, and content this is a big book. Its subject is the bird life of a vast and ornithologically poorly-known part of Canada that encompasses some 600,000 square miles of the Quebec-Labrador peninsula, eastern Hudson and James bays, and part of extreme northwestern Ontario. Its author is one of this continent's most distinguished ornithologists.

It is a long-awaited book that really had its beginning back in 1901 when the author made his first expedition to the wilds of Labrador to study the bird life there. This initiated what was to become a series of no less than 25 expeditions conducted by the Carnegie Museum to the 'north country'. The valuable results of these expeditions, heretofore unpublished, are presented in this book. In addition, related data from all other available sources, published and unpublished, are meticulously brought together, documented, and competently appraised.

There are 72 pages of introductory material, the bulk of which (pp. 13-57) is devoted to the itineraries and interesting narratives of the 25 Carnegie Museum expeditions. The geography, physiography, general geology, climate, population and resources, ecological conditions, life zones, and geographic history are dealt with briefly. A good history of previous ornithological work in the area is given.

The systematic list of birds (pp. 73-723) makes up the main body of the book. Each subspecies is treated as a separate unit. Treatment of distributional data is uniform and thorough. For each subspecies there is a list of the literature references arranged by the various names used by the authors concerned. There is usually a list of additional records and one of skins and eggs examined by the author. The details derived from these published sources and the great mass of records and observations gathered by the Carnegie Museum expeditions are then presented in an orderly and readable manner.

Emphasis is on bird distribution and the data presented are well documented and definite. In many cases locality records are plotted on maps. The significance of climatic, ecological, and topographic features as factors affecting bird distribution is often indicated. Migration dates are cited when available.

Taxonomic studies of many of the forms are an important aspect of the book. While not everybody will agree with all of the opinions expressed (for example, the treatment of the Blue-Snow goose complex) many have much merit. For instance, the treatment of the eastern races of *Passerculus sandwichensis* is, in this reviewer's opinion, by far the most realistic one that has yet appeared in print.

A feature of the text is the author's frank, unbiased, and common-sense appraisal of published data that for one reason or another seem questionable. He concludes, for instance, that in so far as Labrador is concerned, too much respect has been paid to J. J. Audubon as an authority, and that many of Audubon's published records must be expunged. To this reviewer this view appears to be long overdue.

In such a laborious undertaking, involving overwhelming detail, a few minor oversights are inevitable. For instance, the author states that he is not aware of the authority for the Baie Johan Beetz record of the Dickcissel cited in the A.O.U. Check-list (ed. 5, p. 555). This is based on a collected specimen and was published in *The Auk* 71(3):317. There is no reference in the book to the

Ruff, *Philomachus pugnax* although there is a generally overlooked record of a "magnificent" male shot at Seven Islands, Quebec, on May 27, 1933, in the collection of the late Dr. D. A. Dery (Provancher Society of Natural History of Canada, Annual Report for 1933, p. 15).

A very few questionable assertions are made such as (p. 373) that murres sometimes undertake a southward migration from Hudson Bay to the Great Lakes, or (p. 646) that the Evening Grosbeak is still a casual summer resident in New Brunswick (it is now one of the common summer birds there). Such questionable assertions are exceptional and the work is characterized by meticulous accuracy and astute observation and interpretation.

An extremely useful adjunct of the book is a 32-page gazetteer of localities which is skilfully prepared and annotated. The 54-page (double columns) bibliography, each item of which is expertly annotated, is another extremely useful feature.

Eight colored plates by George M. Sutton add beauty to the book and in a number of species show rarely-pictured and evanescent juvenal or the downy plumages. A colored plate by C. L. Ripper effectively portrays the natal plumages of four grouse. A considerable number of photographs showing habitats, terrain, and other interesting aspects of this rugged country are included.

This important work fully maintains the very high standards that have long characterized the author's publications and will be indispensable, now and for a long time to come, to anyone interested in the bird life of the large part of the country that it covers.

W. EARL GODFREY

Birds of the Lake Athabasca Region, Saskatchewan

By ROBERT W. NERO. 1963. Saskatchewan Natural History Society, Special Publication 5. 1943 pp. Illustrated. $2.50.

This useful and attractive publication presents an excellent account of the bird life of the Lake Athabasca region, Saskatchewan. Actually it considerably transcends the northwestern part of the province and gives a much clearer picture than has been possible heretofore of bird distribution in northern Saskatchewan in general south to Clearwater and Churchill rivers.

The Lake Athabasca data are based mainly on the author's very creditable field work there in the summers of 1960, 1961, and 1962 and he has included also data from all other available sources, both published and unpublished, notable among which are notes made by Francis Harper in 1914 and 1920, and by T. M. Shortt in 1945.

The copiously-annotated list of birds contains much definite and authentic information on distribution, status, and dates for each species in the area, and for many of those species there are notes also on behavior, aspects of the breeding cycle, and ecology. Substantial additions are made to the known breeding ranges of several species, and nesting is established for a number of others where it was only suspected heretofore. Valuable data are given also for more eastern parts of northern Saskatchewan, notably Hasbala Lake in the extreme northeast.

The introduction includes a general account of the author's three expeditions, a good summary of previous work by others, a description of the area, notes and comments on bird distribution there, and a map of the area. The report is illustrated by photographs of bird habitats and other subjects. Interesting drawings by Ralph D. Carson are scattered through the text. This report adds vastly to our knowledge of the birds of northern Saskatchewan.

W. EARL GODFREY

Cacti and Other Succulents

By R. GINNS. Penguin Books Ltd., Harmondsworth, Middlesex, England, 1963. 191 pp., 125 half-tone pl., 5 text fig. (Canadian distributer: Longmans Canada Ltd., Paperback Division, 55 Barber Greene Road, Don Mills, Ontario. $1.85).

This small book is the most pleasant and handsome introduction to the study and culture of succulent plants which has yet appeared. The profusion of really excellent photographs, beautifully reproduced, shows for the most part close-up views of either small mature plants or of well-grown seedlings of large species, thus portraying the plants as the home grower is most likely to see them. There is also a generous smattering of photographs of larger plants including a few in the wild.

The text is well and interestingly written to present an outline of the habitats of succulent plants, much detail on methods of culture and, for the latter half of the book, a short description of a number of genera and species well suited to pot culture.

Although the book is written for an English audience, the directions for culture are generally satisfactory for Canadian growers. North American readers might like to use the University of California soil mixes rather than the John Innes formulas, or for epiphytic plants the chopped sphagnum moss medium developed and used with great success by the Montreal Botanic Garden.

Mr. Ginns gives a too brief list of more extensive reference books. Those wanting more information on the botany, especially the taxonomy of these plants should refer to:

The Cataceae by N. L. Britton and J. N. Rose. Reprint 1964, Dover Publications, Inc., New York, N.Y. 1066 pp., 1279 ill., 2 vols. cloth $20.00 (U.S.)

A Handbook of Succulent Plants by Hermann Jacobsen, 1960, Blandford Press, London. 1441 pp., 1617 fig., 3 maps, 3 vols. $45.00 (U.S.)

Die Cactaceae, by Kurt Backeberg, recommended by Mr. Ginns, is a very beautiful German work but should be used with caution, since Backeberg is the most notorious splitter among cactus taxonomists, and many of his names will not stand.

The best American journal for amateurs is the *Cactus and Succulent Journal* of the Cactus and Succulent Society of America. This magazine is $5.00 (U.S.) per year (*6* issues) and may be ordered from Scott Haselton, Editor, 132 West Union Street, Pasadena, California.

To return to Mr. Ginns' book, we can recommend it wholeheartedly to anyone interested in succulent plants, especially cacti. The book is free from important technical blunders, most of the few detected being the result of incomplete statements, unavoidable in so short a work.

Anyone who buys the book may want to buy plants as well. Aside from local shops, the only Canadian grower of importance is Ben Veldhuis, Dundas, Ontario, who deals with the public mostly through visits to his greenhouses. Other sources may be found in classified columns of gardening magazines or in the Cactus and Succulent Journal.

E. W. GREENWOOD
Ramsayville, Ontario

Handbook of North American Birds, Vol. 1. Loons through Flamingos

Edited by RALPH S. PALMER. Yale University Press, New Haven. 1962. 567 pp. $15.00.

When all volumes of this handbook are published they will constitute the most comprehensive assemblage of facts on North American birds that has ever been available. Everyone with a professional interest in birds, and many serious amateur students of ornithology, should have access to the set.

For each species, information is given under the following headings: diagnostic characters, detailed description of the

definitive stage (the Villalobos system of colours is used), descriptions of plumages and moults, measurements, weight, colour phases, hybrids, diagnostic description of subspecies, field marks, voice, habitat, distribution (maps show breeding range, wintering range, and, in some instances, migration routes and areas of hybridization), migration, banding studies, reproduction, survival and longevity (if data are available), habits, and food. The preceding list gives some idea of the breadth of this work; it scarcely conveys any idea of its detail.

Different sections and subsections are the work of different authors, who are identified by their initials. All data are credited. A telegraphic style of writing is employed. Not all species are illustrated, but colour plates depict some of the less familiar characteristics of plumage and soft part colouration. Black-and-white sketches illustrate some aspects of behaviour.

DAVID A. MUNRO

Canadian Wildlife Service
Ottawa, Ontario

Minnesota's Rocks and Waters: A Geological Story

By GEORGE M. SCHWARTZ and GEORGE A. THIEL with the assistance of Peggy Harding Love. The University of Minnesota Press, Minneapolis. Revised (second) Edition. 1963. 366 pp.; 161 illustrations. $4.50. (Minnesota Geological Survey Bulletin 37). Canadian representatives: Thomas Allen Limited, 266 King Street West, Toronto.

The State of Minnesota, comprising over 84,000 square miles, is situated approximately in the central part of North America. Its surface waters drain in three major directions: to the northward into the Red River and eventually Hudson Bay, to the eastward into Lake Superior and the Atlantic Ocean, and to the south by the Mississippi into the Gulf of Mexico. Its northern boundary is Canada, and while the volume was prepared for the citizens of Minnesota its description of the geological features and how they were developed will be of great interest to many Canadians.

The landscape is composed of lakes, swamps and rivers—of hills, ridges and plains—of farm country, and rocky area in the northern part. It contains some 14,000 lakes, giving a larger water area than any other state in the union. The details of the surface were largely produced by continental glaciers which advanced and in turn retreated during the Great Glacial Age. The last glacier retreated from Minnesota as recently as 11,000 years ago.

Over the greater part of the state the consolidated rocks at the surface are of Precambrian age. They are ancient lava flows, intrusives, and sediments including iron-formations. The length of Precambrian time and the absence of fossils for dating any beds makes correlation in widespread areas difficult. In Minnesota these rocks are regarded as having formed in three geological eras: the Early Precambrian, the Middle Precambrian, and the Late Precambrian. Most of Canadian geologists prefer to divide Precambrian time into two eras, an older called the Archaean and a younger era named the Proterozoic. Both of these are subdivided, the Archaean into the Keewatin and the Timiskaming, and the Proterozoic into the Huronian and the Keweenawan. In the southern part of the state are Cambrian, Ordovician and Devonian strata but Upper Paleozoic and Lower Mesozoic ages are not found. Rocks of Cretaceous rest on Precambrian and on early Paleozoic formations.

The mineral resources are of very great value. The chief production is iron ore. The total production in the state up to January 1, 1962, was 2,529,737,533 tons. Toatl taxes paid on iron ore to January 1, 1961, were approximately $1,257,448,400., a very important source of funds for the state government. Some 60 per cent of the total produced in the United States has come from Minnesota. Three iron ranges are the Mesabi, the

Vermilion and the Cuyuna. Other mineral resources in the state are architectural, monumental and structural stone, produced from granite, limestone, dolomite and other rocks; gravel and sand are excavated and clay is used for many ceramic products.

F. J. ALCOCK

398 Third Avenue
Ottawa, Ontario
Dr. Alcock is a former director of the National Museum of Canada.

Les Libellules du Québec

By ADRIEN ROBERT, C.S.V. Ministère du Tourisme, de la Chasse et de la Pêche, Province de Québec. Service de la Faune, Bulletin 1. 1963. 223 pages, 278 figures.

Now that the taxonomy of the Canadian Odonata rests on a firm foundation, there is a place for popular regional manuals which will encourage the beginner and provide an abridged yet adequate guide for the local collector. Brother Robert's book is designed to meet this need for Quebec, a province in which he has studied dragonflies actively for more than twenty-five years. It is appropriate that this province should be the first in Canada to devote a handbook to its dragonflies. It contains at least 130 of the some 200 species recorded from Canada; and yet, with its northern parts extending beyond tree-line, it offers environments which limit the distribution of dragonflies as a group. This handbook will therefore foster interest in these insects in an area where their study should be singularly rewarding.

Printed in an edition of 1,000 copies, this book is sent free to libraries and entomologists who apply to the publisher (at 5075, rue Fullum, Montreal). Entomologists will be gratified that the Ministry has devoted the first bulletin of this series to an insect group; and this being so, the choice of dragonflies was a happy one. The behaviour of these striking and beautiful creatures can readily be observed in nature, their capture frequently offers a challenge to the ingenuity and patience of the collector, and they are particularly numerous near lakes and rivers where so many people congregate during the summer.

The book is arranged in three parts. In the first, which provides a general introduction to the order, there are sections devoted to the structure and life-history of the larva and adult; the relationships of dragonflies with other animals (predators, prey, parasites, etc.); the history of studies on the order in Quebec; and methods of collection and preservation. The second, principal part (of 112 pages) comprises a key for identification of adults, and the third part an annotated list of species with brief remarks on their dates of adult appearance and distribution. An addendum and bibliography of 62 references complete the text. The book is liberally illustrated with bold, clear line-drawings and eleven well-produced photographs; the latter show typical habitats and are unusually attractive.

Information is clearly presented, and great care has been taken to make the key incisive and easy to use. An excellent feature is the accompanying drawings in which pertinent characters are indicated by arrows. This will earn the gratitude of all who use the key, and (we may hope) provide a precendent to be followed in subsequent bulletins of this series. The author's aim—to provide a guide for identification—has been effectively fulfilled: this book should certainly be possessed by all who intend to study dragonflies in or near Quebec. But it also provides a readable introduction to the Odonata, and draws attention to the varied and fascinating problems their study offers the naturalist. It would therefore make a useful addition to any high school library.

The few errors lie in the illustrations or their captions and only one is serious. This is the portrayal (page 36) of a pair of *Coenagrion interrogatum* ovipositing in a manner exemplified by neither sub-

order. To be correct (and typical of the sub-order this species represents) this figure should show the female legs grasping a support, and the eggs being inserted into plant tissue. Less important sources of potential confusion include the terminology of the larval labium, which does not conform to current usage, and the use of the ambiguous (though possibly correct) generic name *Agrion* instead of *Calopteryx*. These shortcomings represent minor and exceptional departures from the high standard which characterizes the text and illustrations.

The author and publishers are to be congratulated on producing this attractive and eminently useful handbook.

PHILIP S. CORBET

Entomology Research Institute
Canada Department of Agriculture
Ottawa, Ontario

Investigations in the Natural History [Floristics and Geo-morphology] of the Soviet Far East [Kamtchatka] *Issledovanie prirody dal'nego vostoka)*

E. PARMASTO, Editor. A collection of papers published as No. 450 of the Academy of Sciences of the Estonian S.S.R., Tartu, 1963. 1.54 rubles.

The text is in Russian, but each paper is followed by a clear English summary, sufficiently detailed for evaluation of the work. The translated table of contents lists the following:

Kaarel Orviku. On the Morphology of the Coast of Kronoki Bay (9 pp., 4 photographs);

A. V. Raukas. On the Geology of the Geyser Valley (17 pp., 6 photographs);

A. Raik. On the Regime of Kamchatka Geysers (56 pp., 8 photographs);

Kaarel Orviku & A. Raukas. Geyserites in the Geyser Valley, Kamchatka (15 pp., 12 photographs);

H. Trass. On the Vegetation around Hot Water Springs and Geysers of Geyser Valley, Kamchatka (34 pp., 7 photographs);

E. Kukk. On the Algal Flora of the Geyser Valley (12 pp., 30 species);

H. Trass & E. Lellep. Floristical Notes from Kamchatka and the Island of Medny (9 pp., 112 species);

H. Trass. On the Lichen Flora of Kamchatka I. (50 pp., 218 species including 1 sp. nov., 2 vars. nov., 8 f. nov., and 3 comb. nov.; 9 figures of gross characters);

E. Parmasto. On the Fungus Flora of Kamchatka (68 pp., 185 species including 3 sp. nov., 1 var. nov., 2 f. nov., 3 comb. nov.); 7 photographs, 7 figures mainly of the spores of 7 species;

T. Nikolajeva. The Hydnaceae in Kamchatka and Kunashir (9 pp., 30 species, 2 figures);

A. Raitviir. List of Fungi belonging to the order Helotiales collected in Kamchatka and Kunashir (5 pp., 18 species including 1 sp. nov., 1 comb. nov.);

A. Raitviir. List of Dacrymycetales and Tremellales collected in Kamchatka and Kunashir (4 pp., 14 species).

Four striking color reproductions of paintings from the area add to the artistry of the book which is attractively designed and bound, legibly printed. For those of us completely unfamiliar with Kamchatka, and for all interested in floristics and especially for taxonomists in the groups covered, this book is an essential addition to the scientific library and desirable in the personal library.

LUELLA K. WERESUB

Plant Research Institute
Canada Department of Agriculture
Ottawa

NOTES

Changing Status of the Cowbird in Prince Edward Island

Prior to 1960 the Eastern Cowbird, *Molothrus ater ater* (Boddaert), was recorded from Prince Edward Island on but four occasions. Godfrey (1954, National Museum of Canada Bulletin 132: 155-213) reported observations of three birds made in 1933 and 1947; and Mills (1957, Nova Scotia Museum of Science Newsletter 2(2):25-27) recorded one bird each in 1953 and 1954, with evidence of breeding. Its status in Nova Scotia is given by Tufts (1962, *Birds of Nova Scotia*) as a rare summer resident until 1950, then increasing as a permanent resident seen more often in winter than in summer.

The writer first recorded the Cowbird through a reliable report from Bideford, Prince County, in the fall of 1960. On April 15, 1961, one male and one female were observed at Ellerslie, Prince County; and from April 16 to 29, eight birds remained in that district. None were seen again until October when several adults and juveniles, and a flock of about twenty-five were recorded from Ellerslie. On April 9, 1962, a few were seen among flocks of Starlings and Common Grackles which might have been female Cowbirds, but conditions were unfavourable for identification.

In 1963 the Cowbird was frequently observed. Fourteen birds representing both sexes were recorded from Ellerslie May 4-28. Thirteen juveniles, often accompanied by Robins, Flickers, or Sparrows, were seen in central Prince County during late July; and about sixty Cowbirds were recorded throughout August, mostly associated with other blackbirds foraging in meadows. In the period September 23-October 16 two flocks of about two hundred Cowbirds each, and about ten similar flocks of mixed Starlings and Cowbirds were observed. No parasitized nests have yet been discovered.

A small summer population may have existed here before 1960, for with few observers and an abundance of blackbirds, the Cowbird could remain undetected for some time. However, no resident has yet been encountered who had previously seen the bird. The Cowbirds seen among migrating flocks during late September, 1963, were probably from regions beyond the province, most local blackbirds having left by late August.

Since about 1955 several species of birds apparently have extended their range into Prince Edward Island, or have become more numerous there. Unfortunately, the scarcity of observers here may result in these changes being inadequately documented, as were avifaunal conditions in the past.

Stanley E. Vass

Ellerslie, P.E.I.
4 November 1963

Some Interesting Plants in the Barron Canyon in Algonquin Park

In the course of visits to the canyon of the Barron River we have been delighted to discover several plants whose occurrence was most unexpected. This part of the river, noted for its beauty, is accessible only by canoe. The Barron River drains Grand Lake on the east side of Algonquin Park and joins the Petawawa River not far from its junction with the Ottawa. Judging from the vegetation, this area is similar to the general surrounding terrain in having the acid soil of the southern part of the Canadian Shield.

During our first visit in October 1961 we found that one of the rare rock cresses *Arabis Holboellii* Hornem. grew on exposed rock ledges. We had previously seen it on the rocks of the lower

Barron and T. C. Brayshaw of the Petawawa Forest Experimental Station has found it nearby on the Ottawa River on the face of famous Oiseau Rock.

Celastrus scandens L. was fairly common on rock slides and of interest because it bore fruit. Scattered vines of bittersweet are well established at Des Joachim and Deep River but do not fruit as they do in the calcereous soil to the east. It has been suggested that both sexes may not have moved along together and I must check this. These localities are just beyond the limit of spread shown by Soper and Heimburger (1961, *100 Shrubs of Ontario*).

In June of 1962 on the cool, shaded, north-east side we were excited to find *Saxifraga aizoon* Jacq. and one plant of the little spleenwort *Asplenium trichomanes* L. That the occurrence here of the saxifrage is unusual may be inferred from the report of Soper and Maycock (1963, Canadian Journal of Botany 41 (2):183-198). On May 26 of the following year, much to our pleasure since it was a hot day, we encountered a fall of ice in this part of the canyon.

Also on May 26, 1963 we found a colony of another rare crucifer *Draba hirta* L. (*D. arabisans*). A second discovery which defined identification was a unique, evergreen, dwarf shrub or tree about 30 inches tall sprawling at the base of a moss and lichen-covered rock slide. It would not appear to be a new species, but rather a mutant of some more common plant as there are three forms of needles or branches. In appearance it is rather like a large *Cassiope mertensiana* (which of course it could not be, so far out of range) with a few branches of enlarged needles of *Juniperus horizontalis* and a few more of *J. communis*. W. G. Dore, by sectioning a part of the stem, has established that it is a conifer of several years growth and it is said by C. Frankton to smell of cedar.

Three more visits were made in 1963. In mid-June we located *Dryopteris fragrans* (L.) Schott var. *remotiuscula* Komarov. The presence on the Barron of this fern has been reported by T. C. Brayshaw who first discovered it there (*In press*, Canadian Field-Naturalist).

In September, after examining many rock ferns, a small colony of the glandular, jointless *Woodsia cathcartiana* Robins, was found. B. Boivin who made the identification considers this to be a form of *W. oregana*. The plants were on a dry, exposed rock and earth face on the south-east side. A few more specimens of *Asplenium trichomanes* were located. Several plants of *Dryopteris fragrans* were seen under a moist overhang beside the main waterfall and it was also observed on dry rock slides where little grew except this and the common *Woodsia ilvensis*. *D. fragrans* is evidently fairly common in the canyon and also, we have observed, on the cliffs of the Mattawa River between Pimisi Bay and the Talon Chute. In addition to the plants found in the canyon, we have collected *Cephalanthus occidentalis* L. (button-bush), *Acorus calamus* L. (sweet-flag) and the uncommon *Viola primulifolia* L. along the shores of the Barron River. *Ceanothus ovatus* Desf. has been observed in the canyon and along the valleys of the Chalk and Petawawa rivers but not to the west.

In conclusion it is noted that the Barron and Petawawa Rivers are considered to have been part of an old drainage system between the Upper Great Lakes and the Champlain Sea which once filled the Ottawa valley. The plants may have arrived at this time, then become stranded in crevices of the cliffs where they found survival possible. Some of them are known to require lime in the soil. This region is underlain mainly by acid, granitic rocks and the occurrence of lime would be unusual. However, it might occur in glacially transported soils or the plants may signify the presence of calcium bearing rocks such as the Grenville-type limestones known to occur nearby, or of other calcium-bearing rocks, such as amphibolite or other basic rocks, that occur within the complex of

igneous and metamorphic rocks of the Canadian Shield. Whatever the reason, these unusual occurrences make the canyon of the Barron River of considerable interest botanically.

I wish to acknowledge the advice of the members of the Plant Research Institute, Ottawa, mentioned above to whom specimens were submitted and of N. R. Gadd of the Geological Survey of Canada.

MARY I. MOORE

6 Laurier Ave.
Deep River, Ont.
12 November 1963

The Holotype of the Franklin Grouse (*Canachites franklinii*)

STENHOUSE (1930, Novitates Zoologicae 35:270-276) calls attention to the existence in the Royal Scottish Museum, Edinburgh, of a specimen of *Canachites franklinii*, probably the type specimen. I have recently examined the specimen to determine any further details about it.

The specimen is now catalogued as 1930/183 in the museum, and bears two labels. One, evidently originally attached to the stand of the bird while it was on display as a mounted specimen, bears no data of significance except the written statement on the reverse "Exhibited Wernerian Society, 20.2.1830". The ink, and the position of this note relative to the position of the red "Type" label of recent origin, leads to the suspicion that even this note may have been applied recently. The data upon the museum label were evidently transcribed from the details contained in Douglas' diary, published in 1914. There would, therefore, be grave doubts about the authenticity of this specimen were it not for certain supporting details. In the first place the specimen was originally in the Edinburgh University collection, where it is known Douglas' specimens were deposited. More important, however, and apparently unnoticed heretofore, is that it agrees closely with the description by Douglas of the specimen collected by him on the west side of Athabasca Pass) now in British Columbia) upon May 1, 1827.

As described (Douglas, 1914, *Journal.* London, p. 258) the bird taken was an adult male. It is further stated that: "This being the first I have seen, could not resist the temptation of preserving it, *although mutilated in the legs.*" The specimen in the Royal Scottish Museum has had the right leg shattered just above the foot and the left foot almost removed, apparently by shot. There seems to me, therefore, to be little doubt that the specimen in the Royal Scottish Museum is in fact the one mentioned by Douglas.

Later in his travels, Douglas mentions shooting other specimens. These were taken in the eastern foothills of the Rocky Mountains, in an area that we now know to be inhabited only by *Canachites canadensis* or by a population showing intermediate characters. No mention is made of any specimens being preserved except for the one above mentioned.

When Douglas prepared the original description of *Canachites franklinii* (1833, Transactions Linnaean Society of London 16:139) he included an accurate account of its colour in every detail, except that he remarks in the English, but not in the Latin description, "Tail square . . . black, white at the points". The tail in *franklinni* is almost always completely black, as it is in the specimen here described. It is safe to assume that the statement was based on his memory of the other individuals shot in the foothills and believed by him to be the same as his first specimen. These eastern foothill birds do in fact have the tail tip yellowish brown or dirty white. The inadequate description of the female was also no doubt added from memory and without reference to a specimen. Another product of faulty memory is the statement in the original description that the flesh is white, whereas in his diary he records accurately that the flesh was dark.

Although Douglas makes no specific mention of any specimen in his original

description, and thus designates no type specimen, his treatment, in prior position, of the male plumage in detail that was not merely extracted from his diary, leaves no doubt that he had a male specimen before him. In my opinion the specimen in question is the one now in the Royal Scottish Museum and, as the only specimen known to have been in the possession of the describer, can be regarded as the holotype. The type locality then becomes Athabasca Pass, British Columbia, on the headwaters of the Canoe River.

I. McT. COWAN

Department of Zoology
University of British Columbia
Vancouver 8, B.C.
18 November 1963

Bushy-tailed Wood Rat in the Peace River District, Alberta

THE DISTRIBUTION OF THE BUSHY-TAILED WOOD RAT, *Neotoma cinerea drummondi* (Richardson), is usually reported as including the Peace River district of British Columbia, without mention of the Alberta section (Rand, 1948, National Museum of Canada Bulletin 108:162-163; Hall and Kelson, 1959, *The Mammals of North America* 2:704).

Soper (1948, Journal of Mammalogy 25:59) reported the species in the Wapiti River valley south of Wembley, Alberta. He was informed that it formerly occurred at Dunvegan, but had been recently exterminated. It seems desirable, therefore, to record a specimen in the National Museum of Canada from Dunvegan, Alberta. The specimen (no. *11573*), a juvenile male, was taken by Dr. L. S. Russell on August 30, 1932, at his field camp on the banks of the Peace River just east of Dunvegan (Section 8, Township 80, Range 4, W.6).

It appears that bushy-tailed wood rats (or pack rats), emigrated from the Rocky Mountains eastward down the river valleys into the Peace River District of north-western Alberta.

A. W. F. BANFIELD

National Museum of Canada
Ottawa, Ontario
10 December 1963

The Stonecat, *Noturus flavus*, Newly Recorded in Alberta

THREE SPECIMENS OF the stonecat, *Noturus flavus* Rafinesque, were caught in the Milk River, about 18 miles west of Wildhorse, Alberta, on the night of June 19-20, 1962, by J. R. Nursall and R. C. B. Hartland-Rowe, who were participating in a faunal survey of the Milk River canyon for the University of Alberta.

The party was stationed at the winter camp of George Ross, a rancher of the district; the fish were captured at the camp. The water was thick with sediment ("milky") and the current was swift. At 9:00 a.m., June 19, 1963, the water temperature at the camp was 19.6°C, the pH 7.8. Conductivity of the water was about 200 micromhos.

Seining was attempted in the river, but was of limited success, owing to turbulent water and a treacherous, shifting, sandy bottom. Only flathead chub, *Hybopsis* (*Platygobio*) *gracilis* (Richardson), were taken by this method. Subsequently, small traps were fabricated from window screening and wire, baited with hamburger and bacon and staked into the river. The stonecats and several flathead chub were taken by this method.

Seining in oxbows of the Milk River, about one mile east of the Ross camp, produced more flathead chub plus some specimens of the burbot, *Lota lota* (Linnaeus), but no stonecats. Here also were found specimens of the Western Painted Turtle, *Chrysemys picta belli* Gray, as reported by Lewin (1963, Copeia (2): 446-447).

The specimens noted are deposited in the University of Alberta Museum of Zoology, Edmonton. Measurements on *Noturus flavus* are as follows:

Catalogue No.	Total length (mm)	Standard length (mm)	Weight preserved (gm)	Dorsal rays	Anal rays
100	229	193	138	I + 6	16
101	225	192	131	I + 6	16
102	176	153	58	I + 6	16

W. B. Scott (1958, *A Checklist of the Freshwater Fishes of Canada and Alaska*, Royal Ontario Museum, p. 19) said that *Noturus flavus* "is to be expected in southern Canadian plains region, although no valid records exist". In the same place Scott throws doubt on the record of Bissett (1927, Canadian Field-Naturalist 41(6) : 127-128) of *Noturus flavus* in Manitoba. Hinks (1943, *The Fishes of Manitoba*, Manitoba Department of Mines and Natural Resources, 102 pp.) mentioned only Bissett's (1927) record and stated that "the record needs confirmation" (p. 62).

Rostlund (1952, University of California Publications in Geography, 9, p. 274) published a range map for *Noturus flavus*, showing it in the South Saskatchewan River drainage of the southeast corner of Alberta, and the Assiniboine — Red River drainage of Manitoba, with a doubtful distribution between these across southern Saskatchewan. The Manitoba record was based on Hubbs and Lagler (1947, *Fishes of the Great Lakes Region*, Cranbrook Institute of Science, Bulletin 26, p. 72), which was based on Bisset (1927). The Alberta record was from Eigenmann (1895, Bulletin of the U.S. Fish Commission 14: 101-132), who stated (p. 107) that "A number of specimens of this species (150 to 250 mm. long) were obtained with hook and line at night in the Missouri River at Craig, Mont. They were [also] reported to me at Medicine Hat, but I did not procure any specimens at that place." It seems probable to us that verbal accounts of the stonecat from Medicine Hat would refer to specimens taken in the Milk River or its tributaries, which lie about 60 miles south of that city. Eigenmann himself (1895 p. 119) lists *Noturus flavus* only for the Missouri River system.

The species was not listed by Rawson (1949, *A Check List of the Fishes of Saskatchewan*, Royal Commission of the Fisheries of Saskatchewan, Saskatchewan Department of National Resources and Industrial Development, 8 pp.). F. M. Atton (*pers. comm.*) states that no specimens have been collected in Saskatchewan.

The Milk River is tributary to the Missouri River. The stonecat is found in the upper tributaries of this system (e.g., Simon, 1946, *Wyoming Fishes*, Bulletin 4, Wyoming Game and Fish Department, pp. 94-95; Brown, 1962, Proceedings of the Montana Academy of Science 22, pp. 21-26). Mr. W. Alvord (Chief of Fisheries Management, State of Montana Department of Fish and Game) further informs us (*pers. comm.*) that this species has been recovered from the Milk River within Montana.

J. R. NURSALL,
VICTOR LEWIN

Department of Zoology
University of Alberta
Edmonton, Alberta
13 November 1963

LETTER TO THE EDITOR

During early July, 1962, my family and I spent seven days exploring Churchill, Manitoba, and environs. Through the courtesy of Mr. and Mrs. Irwin Smith and mutual use of their truck and canoe, we were able to range as far as Twin Lakes in one direction and Button Bay in another. The Smiths have a deep love and respect for the North and its native peoples, plants and animals. Mr. Smith ("Windy") has background experiences in the North worthy of documentation. The Smiths have been gracious hosts to many amateur and professional naturalists.

In spite of several cold, rainy days and hordes of mosquitoes on two sunny days, we soaked up the magnificence of tundra and forest edge and the great Churchill River and Hudson Bay.

Our first impressions of Churchill's richness of nature came from the displays of native flowers. The natural lavish gardens were a dramatic contrast to the rawness of man-made disturbances of the land and the careless disposal of all sorts of junk. Here is a frontier town and a seaport with its share of Indians and Eskimos, already or fast becoming human derelicts. All too well and woefully illustrated in Churchill are the almost insane and depraved manners in which "civilized" peoples can slash into and depreciate the native beauty of a countryside and can disturb the integrity of Indians and Eskimos.

Within a few hours of beating around Churchill–its truly wonderful "Town Slough", river front and great coastal rocks, pools, pockets of soil and cobble and sand beaches – the thought that Churchill could be a place of great natural beauty began to gnaw away within our reflections. We discovered a few town's people who resented the rough manner in which developers of all sorts, including the armed forces, had treated the area.

Many naturalists have gone to Churchill and tourist excursions are made periodically by train each summer. Yet no one to our knowledge has come out strongly with a proposal that *Churchill is worthy of careful planning with a major goal of preserving its natural beauty and wealth of flora and fauna.* While there we witnessed three white town boys shooting down Parasitic Jaegers. Some of the most beautiful natural gardens and parts of the Town Slough were being used as dumping grounds.

More seriously, we were deeply disturbed by maladjustments obviously existing among the whites, Indians and Eskimos who make up permanent and drifting populations of the area.

There is great challenge all through Canada's North for better planning of towns and for development premised in large part on preservation of natural beauty of the land and integrity of Indians and Eskimos.

Admittedly these observations made by my family and me are sketchy and limited, but we believe they are of import and worthy of reporting.

DOUGLAS E. WADE

Northern Illinois University
Lorado Taft Field Campus
Oregon, Illinois
28 March, 1964.

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WILLIAM COPELAND McCALLA – AN APPRECIATION

A. E. PORSILD
National Museum of Canada, Ottawa, Ontario

William Copeland McCalla, normal school teacher and internationally known amateur botanist, was born on November 8, 1872, at St. Catharines, Ontario, and died at Calgary, Alberta, on August 22, 1962. He grew up in St. Catharines where he received his early education; in the early 1890's he went to Cornell University but, unfortunately, had to discontinue his studies owing to indifferent health and eye troubles. However, he was at Cornell long enough to come under the lasting influence of Dr. L. H. Bailey and Dr. K. M. Wiegand.

McCalla had been interested in plants from early childhood and in his teens took care of the plants in his father's conservatory at St. Catharines; about this time he also became deeply interested in photography. In the summer of 1899 he made his first botanical collecting trip which took him to Banff in the Canadian Rockies. Among the plants brought back were many not previously known from Alberta and even some that proved undescribed. A distinctive western willow, a tiny purple Primula and a western Draba were named for McCalla by the specialists who described and recorded them as new to Science.

For some years McCalla operated "Sunny Acres" fruit farm now a part of the city of St. Catharines. A victim of asthma, he was advised to leave Ontario and in 1913 moved with his family to Edmonton where for one year be became a partner in a construction firm that disappeared with the bursting of the great building boom. In 1914 he bought a farm near Bremner, 13 miles east of Edmonton. For some years he was free of asthma, but soon his health forced him to abandon farming. In 1922 he joined the staff of the Edmonton Normal School as librarian, and later as a teacher of Nature Study. In 1925 he moved to Calgary where he taught Natural History at the Normal School until he retired in 1938. During these years hundreds of student teachers had the stimulating experience of field trips with him and of examining his Natural History specimens and photographs. For teaching purposes McCalla made nearly 1000 hand-coloured lantern slides of plants and animals. Many of these are now in the Department of Botany of the University of Alberta at Calgary, or in the Department of Entomology at Edmonton.

Following his retirement McCalla was able to devote an increasing part of his free time to botanical studies, plant photography, and to extended field trips from Canada's western prairies to the coast of British Columbia, south

Mailing date of this number: 23 December, 1964

FIGURE 1. William Copeland McCalla.

FIGURE 2. Douglas Fir (*Pseudotsuga taxifolia*) on steep bank above Bow River Falls, Banff, Alberta.

through the western States to the Mexican border. On all these he was accompanied by Mrs. McCalla who took a devoted and active interest in his work; she was also an experienced camper and, besides cooking, kept notes and records for her husband. On most of these trips they carried camping equipment so as to be independent of commercial hostelries. Once, when revisiting the habitat of a rare plant, they camped near it for an entire week, until conditions were suitable for obtaining the photographs they had come there to make. This was before the coming of dependable light meters, electronic flashlights and miniature cameras, when the field photographer had to carry a portable dark-room for reloading his plate holders and for making test developments of negatives.

During these field trips McCalla kept adding to his growing herbarium in which he invariably deposited "voucher specimens" of all plants photographed. The winters following the field trips were spent developing and printing his negatives and in the study and classification of plant specimens.

Widely recognized as an authority on the flora of Alberta, McCalla corresponded and exchanged plants with many Canadian and foreign botanists, giving freely of his time and personal observations. Many thousands of duplicates, often of rare or little known western plants, were presented to the herbaria of the National Museum of Canada at Ottawa, the Royal Botanical Gardens at Kew, England, the New York Botanical Garden, and the University of British Columbia. In 1960 McCalla presented his entire herbarium, numbering about 14,000 sheets, to the University of Alberta, Edmonton, together with the negatives of his plant photographs. In the collecting and preparation of botanical specimens McCalla devoted meticulous care and thought, and those selected for his own herbarium, all carefully annotated, were of such exceptional perfection and beauty as is rarely attainable in standard herbarium practice.

During seven field seasons in the Canadian Rockies I was often a guest in the hospitable McCalla residence on the North Hill in Calgary when evenings were spent examining specimens in McCalla's herbarium or in viewing selections from his large collection of exquisite colour transparencies or of black and white prints of wild flowers. A selection of 1411 enlarged wildflower photographs, including many of landscapes and plant habitats, all carefully labelled and mounted in 25 large albums, Dr. McCalla presented to the National Museum of Canada. In a letter dated February 14, 1959, he wrote about these:

"I have considered the matter and have come to the conclusion that nothing could give me the same satisfaction as to present as a gift the 25 albums, containing all 1411 photographic prints, to the National Museum of Canada.

"These photographs were taken over a long period of time and under all kinds of conditions; there were frequent difficulties, I often breathed something like a prayer that I might be able to do justice to the beauty of Nature in front of the camera.

"I had no thought of the financial value of what I was doing. The work was fascinating, challenging, sometimes disappointing, often rewarding—a grand

FIGURE 3. Western Flowering Dogwood (*Cornus Nuttallii*) near Victoria, B.C.

FIGURE 4. Western Flowering Dogwood. $\frac{3}{5}$ natural size.

FIGURE 5. Flowering Bunchberry (*Cornus canadensis*).

FIGURE 6. Flowering Bitter-root (*Lewisia rediviva*) near Cranbrook, B.C. $\frac{1}{2}$ natural size.

FIGURE 7. Pasque-flower or Prairie Crocus (*Pulsatilla Ludoviciana*), near Calgary, Alberta. $\frac{2}{3}$ natural size.

avocation adding to the interest and joy of life. I am happy to have so many of them go to the National Museum where they will be useful and be given good care".

The 25 albums of photographs are now in the National Museum of Canada where they will long remain an invaluable research tool and a lasting source of botanical information and aesthetic pleasure. The six plant portraits illustrating this article are truly representative of Dr. McCalla's photographic skill.

To the hundreds of student teachers who attended his classes and examined his biological specimens or photographs, and to the many who from time to time were able to accompany McCalla in the field, the association with this gifted and knowledgeable student of Nature must have been truly inspiring. Several distinguished Canadian biologists have acknowledged their indebtedness to him for their initial interest in Nature and its many wonders.

In his teaching, and not least in his private herbarium, now in the University at Edmonton, in the thousands of duplicated specimens distributed to other herbaria and in the truly unique collection of photographs presented to the National Museum of Canada, McCalla has left an invaluable heritage to the botanical science, and a great monument to one of the ablest and yet most modest of Canadian botanists. It is most appropriate that the University of Alberta, in 1956, saw fit to confer upon William Copeland McCalla the degree of Doctor of Laws, Honoris Causa.

CHRISTMAS BIRD COUNT

The Kitchener-Waterloo Field-Naturalists' Club has collected and tabulated results of the 1963 Christmas Bird Counts from 26 clubs in Ontario. The tabulated data is contained on a single sheet 11 x 17 inches. Photostatic copies of this interesting data can be obtained from F. W. Cooper, President, K.-W. Field-Naturalist' Club, 317 Highland Road East, Kitchener, Ontario. The price is 25 cents per copy.

It is interesting to note that a total of 133 species and 175,000 individuals were reported by the participating clubs.

PLANT COLLECTIONS FROM CARSWELL LAKE AND BEARTOOTH ISLAND NORTHWESTERN SASKATCHEWAN, CANADA

GEORGE W. ARGUS

W. P. Fraser Herbarium, University of Saskatchewan, Saskatoon, Canada

THE FLORA AND VEGETATION OF NORTHERN SASKATCHEWAN is known primarily from the collections and publications of Professor Hugh M. Raup (1936, 1946) who explored the Saskatchewan portion of the Lake Athabasca region in 1935. Other collections from this area have been made by J. B. Tyrrell in 1892 and 1893 (Tyrrell and Dowling, 1896), and more recently by Scotter (Scotter, 1961; Thompson and Scotter, 1961) in the Black Lake region east of Lake Athabasca. Collections of bryophytes made by Mr. M. Welsh in northern Saskatchewan are included in Conard's list (1957). The Alberta section of Lake Athabasca is better known botanically than the Saskatchewan section and several expeditions were made in northeastern Alberta by H. Raup (1936) and Lucy Raup, who concentrated on the lichens (1928, 1930). More recently collections by Cody (1956) have added to the knowledge of the flora of Alberta. However, northwestern Saskatchewan has been infrequently visited by botanists and most collections are from the shores of Lake Athabasca, with the exception of Scotter's work in the Black Lake region. Prior to this study the vast inland sedimentary region south of Lake Athabasca was unknown botanically.

During the summer of 1962 two localities in the Lake Athabasca region of northwestern Saskatchewan were visited: Carswell Lake and Beartooth Island. These localities were visited as an incidental part of studies in the sand dune region on the south shore of Lake Athabasca. The time spent at each locality was short, three days at Carswell Lake (July 12-14) and two days on Beartooth Island (July 15 and 16), and the total number of collections small; however they have proved to be of floristic importance.

The Carswell Lake region was of particular interest because of the anomalous limestone outcrops in this area and the promise that species unknown in the surrounding region may occur here. The sand blowouts on Beartooth Island led us to suspect that the island may support an unusual flora similar to that of the sand dunes on the south shore of the lake only 14 miles away. However, the flora of Beartooth Island proved to be like that of the north shore of Lake Athabasca and contained none of the endemics known from the south shore (*cf.* H. Raup, 1936).

The 143 taxa listed here only represent a sample of the flora. For the area explored was small, many common species were not collected due to the press of time, and the mosses and lichens were only incidentally collected. However, of the total, 34 taxa are new to northern Saskatchewan, of which two vascular plants, 11 bryophytes, and three lichens are new to the province; 11 taxa are new to northwestern Saskatchewan but have been known from adjacent Alberta; and 33 taxa were previously uncollected from the south side of Lake Athabasca.

The field research was supported by the Institute for Northern Studies, University of Saskatchewan, during my tenure as a National Research Council of Canada Postdoctorate Fellow. My field companion on the expedition was Dr. Robert Nero, ornithologist, University of Saskatchewan, Regina Campus. Dr. Nero (1963) has published an account of the ornithology of the Lake Athabaska region. At Carswell Lake we had the good fortune to accompany a party of geologists including Professor F. Edmunds and Mr. L. Beck and party. My appreciation is extended to the specialists who identified or verified specimens in certain difficult groups and to Dr. Dix for reading the manuscript and helpful suggestions.

CARSWELL LAKE

Carswell Lake (locally known as Trout Lake) is located about 22 miles east of the provincial boundary and 32 miles south of Lake Athabasca (lat. 58° 35′ N., long. 109° 25′ W.). The region south of Lake Athabasca is underlain by sandstone of the Athabaska formation (Tyrrell and Dowling, 1896). Rising out of the gently rolling terrain are a series of limestone escarpments produced by six ridges of fine-grained, highly folded and metamorphosed limestone extending in an arc westward from the southwestern end of Carswell Lake (Blake, 1956). Blake reports that this rock is unknown in the region north and immediately south of Lake Athabasca. Our camp was located near the lake at the foot of a cliff marking the edge of one of these ridges. Botanical exploration was mainly carried out in the limestone area.

The vegetation in the vicinity of the limestone ridges is predominantly open *Pinus banksiana* woods on the uplands and *Picea mariana*, *Larix laricina* muskeg on the lowlands. At the base of the cliffs are mixed *Pinus banksiana*, *Populas tremuloides* woods associated with the shrubs, *Cornus alba* ssp. *stolonifera*, *Amelanchier alnifolia*, and *Prunus virginiana*. Woods of *Picea glauca* are rare and only two small stands of that species were observed. The dry south-facing cliffs and the drier portions of the ridge tops support a xerophytic vegetation including *Juniperus communis*, *J. horizontalis*, *Saxifraga tricuspidata*, *Erigeron compositus*, *et al.* The limestone cliffs also support some taxa apparently confined to calcareous rocks in northern Saskatchewan, including *Pellaea glabella* var. *occidentalis* and *Draba cinerea*. A wet limestone cliff over which water was falling contained an interesting assemblage of plants including *Dryas drummondii*, *Selaginella selaginoides*, *Anemone parviflora*, *Carex leptalea* and the mosses *Cinclidium stygium* and *Bryum pseudotriquetrum*.

BEARTOOTH ISLAND

Beartooth Island is a small sandy-gravel island about three-quarters of a mile long and one-half of a mile wide. It lies near the center of Lake Athabasca about eleven miles east of the provincial boundary. The island consists of sand overlying sandstone boulders and stones, and although it is mapped geologically as Athabasca sandstone no bedrock outcrops were observed.

In the recent past Beartooth Island apparently supported well developed forests of *Picea glauca* and *Betula papyrifera* and the island was passed longingly

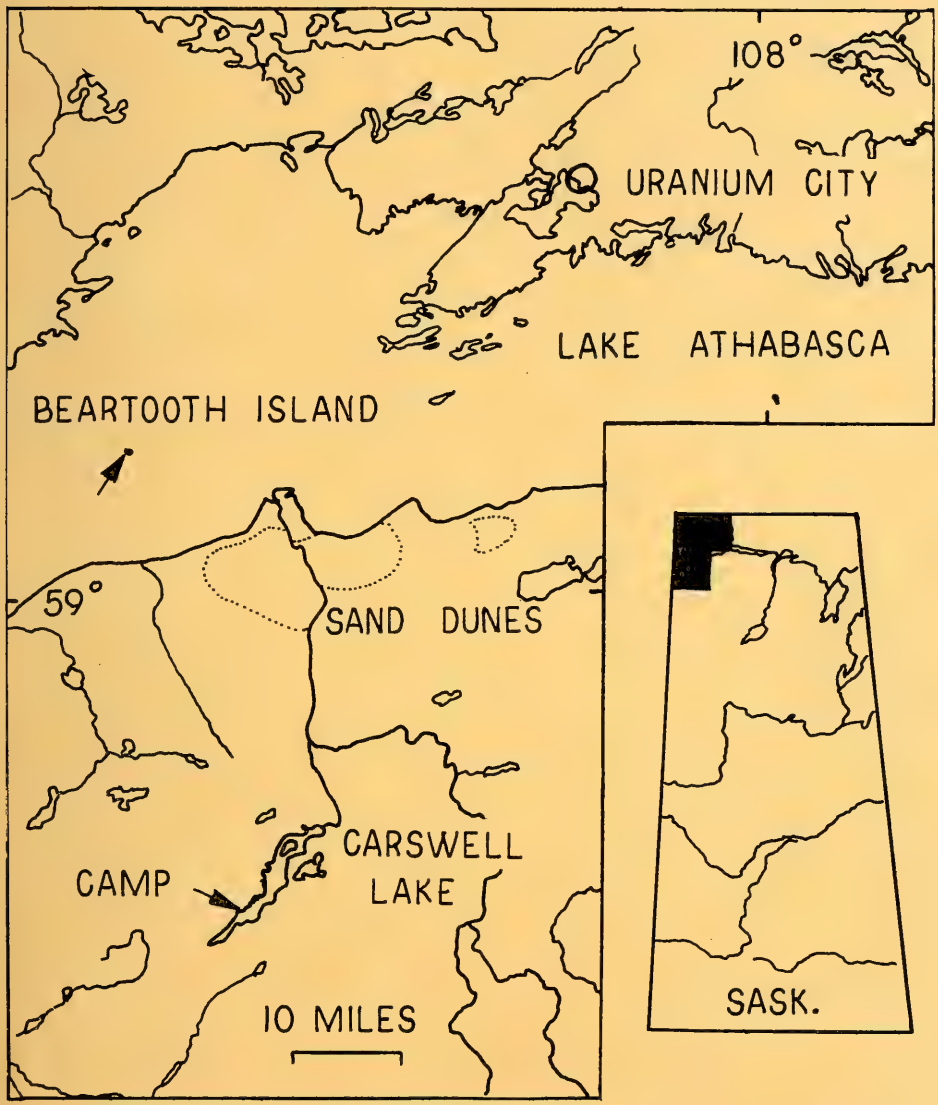

FIGURE 1. Map of northwestern Saskatchewan.

by the biologist F. Harper in 1914 and 1920 (pers. corres. cited by Nero, 1963). However, extensive cutting, presumably for use on wood burning vessels plying the lake, and a major fire about 25 to 30 years ago has changed the aspect of the vegetation considerably. The island now is predominantly sand blowouts and burn regeneration. Only two relatively undisturbed stands of *Picea glauca* woods and *Picea mariana* muskeg occur on the island. Some indication of the age and development of the former *Picea glauca* woods is given

by cut stumps on the eastern side of the island which are 8 to 18 inches in diameter at 3 feet above the ground and 115 to 125 years old.

The blowouts are active although partly stabilized by mats of *Empetrum hermaphroditum*, tufts of *Festuca saximontana* and *Poa glauca*, and scattered individuals of *Picea glauca* and *Pinus banksiana*. *Picea glauca* saplings in some blowouts were determined to be 17 to 21 years old, and a *Pinus banksiana* sapling was seventeen years old. In burns that did not blowout woody species are well established and the vegetation contains saplings of *Picea glauca* and *Pinus banksiana* associated with a mixed shrub cover of *Ledum groenlandicum* and occasional *Prunus pennsylvanica*. The gravel beach surrounding the island is open and the sandstone cobbles and boulders are lichen covered. The older beach levels are vegetated by shrubs including *Ribes glandulosum*, *Prunus pennsylvanica*, *Sorbus scopulina*, *Rubus strigosus* var. *canadensis*, *Salix bebbiana*, and *S. planifolia*. At one point on the shore shrubby specimens of *Populus balsamifera* were noted growing on a submerged stony beach.

AN ANNOTATED LIST OF PLANTS

A complete set of specimens is deposited in the W. P. Fraser Herbarium, University of Saskatchewan. A second set of the vascular plants has been sent to the Department of Agriculture Herbarium, Ottawa. A duplicate set of mosses are in the Herbarium, National Museum of Canada, and a second set of lichens are in the United States National Herbarium, Washington, D.C.

All specimens were identified by the author with the exception of the Polypodiaceae, Musci, and Lichenes which were determined by Drs. R. and A. Tryon, H. Crum, and M. Hale respectively. Several other groups were verified or determined by specialists as indicated.

Three symbols are used to indicate species of particular distributional importance: (NS) indicates taxa new to the flora of northern Saskatchewan, (A-NS) indicates taxa new to northwestern Saskatchewan but known from adajcent Alberta, and (LA-S) indicates taxa known from Lake Athabaska but new to the sedimentary region south of the lake. Taxa observed, but not collected, are cited.

The collection numbers cited in this paper are those of the author.

Vasculares

EQUISETACEAE

Equisetum arvense L.
Carswell L.: on sandy lake shore, *609-62*.

E. fluviatile L.
Carswell L.: emergent aquatic on lake shore, *612-62*.

E. hyemale L. ssp. *affine* (Engelm.) Stone (NS)
Carswell L.: on sandy lake shore, *606-62*.

LYCOPODIACEAE

Lycopodium annotinum L. var. *annotinum*
Beartooth I.: in *Picea glauca* burn regeneration, *639-62*.

L. obscurum L. var. *dendroideum* (Michx.) D. C. Eaton
Beartooth I.: with the preceding, *641-62*.

L. tristachyum Pursh
Beartooth I.: with the preceding, *640-62*.

SELAGINELLACEAE

Selaginella rupestris (L.) Spreng.
Carswell L.: growing on open sand in *Pinus banksiana* woods near the base of limestone cliff, rare, *591-62*.

S. selaginoides (L.) Link (A-NS)
Carswell L.: in wet sandy soil at edge of *Carex* meadow, *538-62;* in moss mat on wet

limestone cliff near waterfall, associated with *Bryum pseudotriquetrum, Campylium stellatum,* and *Cinclidium stygium, 575-62C.*

POLYPODIACEAE

Determined by Drs. R. and A. Tryon

Cystopteris fragilis (L.) Bernh. (LA-S)

Carswell L.: in crevices in limestone boulder at base of cliff, *542-62, 546-62.*

Pellaea glabella Mett. ex Kuhn var. *occidentalis* (E. Nels.) Butters (LA-S)

Carswell L.: abundant in crevices in south-facing limestone cliff, *482-62, 597-62.* The species was cited by H. Raup (1936) from the dolomite hills at Cornwall Bay on the north shore of Lake Athabasca. He noted that it seems to be confined to limestone or dolomitic rocks.

Woodsia glabella R. Br. (LA-S)

Carswell L.: in crevices in limestone boulders at base of cliff, *541-62, 598-62.* Known previously from one locality on the north shore of Lake Athabasca (H. Raup, 1936). This species may also be restricted to calcareous habitats.

PINACEAE

Juniperus communis L. var. *depressa* Pursh

Carswell L.: abundant on dry south-facing limestone cliffs, *495-62.*

J. horizontalis Moench (LA-S)

Carswell L.: common on dry south-facing limestone cliffs, *496-62.*

Larix laricina (DuRoi) K. Koch

Observed at Carswell Lake in muskegs associated with *Picea mariana.*

Picea glauca (Moench) Voss

Observed infrequently at Carswell Lake, but the most abundant conifer on Beartooth Island.

P. mariana (Mill.) B. S. P.

Observed in muskegs at Carswell Lake and Beartooth Island, uncommon at the latter locality.

Pinus banksiana Lamb.

Carswell L.: on a sandy ridge near limestone cliff, associated with a sparse ground flora including *Vaccinium myrtilloides* and *Arctostaphylos uva-ursi, 575-62.* Observed to occur in blowouts and burn regeneration on Beartooth Island.

TYPHACEAE

Typha latifolia L. (A-NS)

Carswell L.: emergent aquatic on lake shore, *622-62.*

NAJADACEAE

Potamogeton filiformis Pers. var. *borealis* (Raf.) St. John (A-NS)

Carswell L.: aquatic in lake, water 2 to 3 feet deep, sand bottom, *624-62.*

P. gramineus L.

Carswell L.: aquatic, with the above, *623-62.*

GRAMINEAE

Determined or verified by Dr. W. Dore

Calamagrostis canadensis (Michx.) Beauv.

Carswell L.: uncommon in *Picea glauca* woods, *610-62.*

C. purpurascens R. Br. (LA-S)

Carswell L.: in *Pinus banksiana* woods on limestone ridge, *545-62;* common on dry face of limestone cliff, *490-62.*

Elymus innovatus Beal (NS)

Carswell L.: in *Pinus banksiana* woods on limestone ridge, *544-62.* Known previously from Ft. Smith and Calumet in northeastern Alberta but uncollected from western Lake Athabasca (H. Raup, 1936). Known in Saskatchewan from Methye Portage southwest of Cree Lake.

Festuca saximontana Rydb.

Carswell L.: in *Pinus banksiana* woods on limestone ridge, *480-62;* sandy lake shore, *605-62;* Beartooth I: in partly stabilized sand blowout, *644-62;* in burn regeneration, *642-62;* on old gravel beach, *634-62.*

Poa glauca Vahl

Carswell L.: on dry south-facing limestone cliff, *485-62;* on sandy lake shore, *608-62.* Beartooth I.: common on gravel beach, *631-62, 633-62, 637-62;* in partly stabilized sand blowout, *645-62.*

P. pratensis L.

Beartooth I.: on gravel beach, *632-62.*

P. interior Rydb. (LA-S)

Carswell L.: on dry south-facing limestone cliff, *497-62.* This species was not reported by H. Raup (1936) but it was collected at Ft. Smith by Cody (1956) and at Faraud and Dodge Lakes by Scotter (1961). The identity of this individual (*497-62*) was considered questionable by Dr. Dore; however, he noted, "some 'sprawly' cliff plants like this grow into *P. interior* in my garden!"

Schizachne purpurascens (Torr.) Swallen (LA-S)

Carswell L.: in *Pinus banksiana* woods on sand ridge, *558-62.*

CYPERACEAE

Determined or verified by Dr. F. Hermann.

Carex buxbaumia Wahl.

Carswell L.: in *Carex* meadow at edge of pond, *559-62*.

C. capillaris L. ssp. *chlorostachys* (Stevens) Löve, *et al.* (*C. capillaris* var. *elongata* Olney) (LA-S)

Carswell L.: on wet limestone cliff near waterfall, *517-62*, *573-62*.

C. deflexa Hornem.

Beartooth I.: forms small mats in burn regeneration on sandy soil, *638-62*.

C. disperma Wahl. (LA-S)

Carswell L.: in wet *Picea mariana*, *Salix* spp. woods on limestone ridge, *584-62*.

C. eburnea Boott (LA-S)

Carswell L.: on dry south-facing limestone cliff, *493-62*. Previously known from only one locality on the north shore of Lake Athabasca (H. Raup, 1936).

C. foena Bailey (LA-S)

Carswell L.: on sandy lake shore, *607-62*. Collected previously by Scotter (1961) at Higginson Lake east of Lake Athabasca.

C. interior Bailey (NS)

Carswell L.: in *Picea mariana*, *Larix laricina* muskeg, *506-62*.

C. leptalea Wahl. (A-NS)

Carswell L.: with the above, *505-62;* on wet limestone cliff near waterfall, *572-62*.

C. rossii Boott (NS)

Carswell L.: on dry south-facing limestone cliff, *489-62*.

C. scirpoidea Wahl. (LA-S)

Carswell L.: on edge of *Carex* meadow, associated with *Carex buxbaumia* and *Antennaria pulcherrima*, *561-62*.

C. tonsa (Fern.) Bickn.

Carswell L.: in *Pinus banksiana* woods on sandy limestone rubble, *467-62*.

Eriophorum viridicarinatum (Engelm.) Fern. (A-NS)

Carswell L.: in *Picea mariana* muskeg, *517-62*.

JUNCACEAE

Juncus balticus Willd. var. *littoralis* Engelm.

Carswell L.: in *Pinus banksiana* woods on sand ridge, *547-62*.

LILIACEAE

Tofieldia glutinosa (Michx.) Pers. (NS)

Carswell L.: in wet sandy soil at edge of *Carex* meadow, *536-62;* in *Picea mariana* muskeg, *511-62*. Rare in northern Saskatchewan and adjacent Alberta. Previously known only from the Wood Buffalo Park (H. Raup, 1935).

ORCHIDACEAE

Habenaria hyperborea (L.) R. Br. (LA-S)

Carswell L.: in *Picea mariana* muskeg, *512-62;* in marsh at edge of pond, *615-62*.

SALICACEAE

Populus balsamifera L.

Beartooth I.: on submerged gravel beach, *655-62*.

P. tremuloides Michx.

Observed at Carswell Lake growing at the foot of limestone cliffs in association with *Pinus banksiana*.

Salix bebbiana Sarg.

Carswell L.: in *Pinus banksiana* woods on limestone ridge, *519-62*, *520-62;* in *Picea mariana* muskeg, *508-62*. Beartooth I.: on old gravel beach, *628-62;* on exposed gravel bar extending out from island, *636-62*. This species occurs as shrubs 2 to 7 feet tall, on Beartooth Island decumbent specimens were noted. The decumbent specimen from Beartooth Island (*636-62*) is an unusual variant of *S. bebbiana* resembling material of the variety *capreifolia* Fernald from the Gaspé Peninsula, Quebec. Although considerable variation is expected in *S. bebbiana* this specimen with its long, elliptic to obovate leaves (6-7 cm. long), densely tomentose immature leaves, prominent stipules (up to 10 mm. long), long pistillate aments (6-7 cm. long), and long capsules (9-11 mm. long) is altogether different from any material I have seen in western Canada.

S. candida Fluegge ex Willd. (NS)

Carswell L.: locally common on the boggy margin of a pond, shrubs 5-8 feet tall, *516-62*, *523-62*. The species is generally rare in northern Saskatchewan.

S. myrtillifolia Anderss. (LA-S)

Carswell L.: in *Picea mariana* muskeg, *504-62;* on wet limestone cliff near waterfall, *570-62*.

S. pedicellaris Pursh (including var. *hypoglauca* Fern.)

Carswell L.: common in *Picea mariana* muskeg, *503-62*, *510-62*, *515-62*.

S. pedicellaris X *S. planifolia* (NS)

Carswell L.: in *Picea mariana* muskeg, shrubs 1-3 feet tall, common, *498-62*, *499-62*, *501-62*, *502-62*, *507-62*, *514-62*, *516-62*, *522-62*. This hybrid is common in muskegs in the boreal forest of Saskatchewan where the parental species occur in some abundance. A paper dealing with this hybrid and its possible connection with *S. athabascensis* Raup is in preparation.

S. planifolia Pursh

Carswell L.: common in *Picea mariana* muskeg, 4-5 feet tall, *500-62;* shrub 12 feet tall, with the preceding, *509-62*. Beartooth I.: on gravel beach, shrub 7 feet tall, *630-62*.

S. scouleriana Barr.

Carswell L.: in *Picea glauca* woods, *611-62;* on the edge of *Pinus banksiana* woods and a *Picea mariana* muskeg, *518-62*.

S. serissima (Bailey) Fern. (LA-S)

Carswell L.: lake edge, rare, *604-62*. Previously known from one locality on the north shore of Lake Athabasca (H. Raup, 1936). Uncommon in northern Saskatchewan.

MYRICACEAE

Myrica gale L.

Observed at Carswell Lake in a *Picea mariana, Betula glandulosa* scrub on a boggy pond margin.

BETULACEAE

Alnus crispa (Ait.) Pursh

Carswell L.: in *Pinus banksiana* woods on limestone ridge, *470-62*.

Betula glandulosa Michx.

Carswell L.: on boggy pond margin, associated with *Picea mariana, Myrica gale,* and *Ledum groenlandicum, 526-62*.

B. papyrifera Marsh.

Observed at Carswell Lake and on Beartooth Island, uncommon.

POLYGONACEAE

Rumex mexicanus Meisn.

Beartooth I.: rare on old beach gravels, *635-62*.

R. occidentalis S. Wats. (A-NS)

Carswell L.: in marsh on lake edge, *620-62*.

CARYOPHYLLACEAE

Arenaria stricta Michx. ssp. *dawsonensis* (Britt.) Maguire (LA-S)

Carswell L.: on a limestone scree slope below ridge, uncommon, *530-62*.

Stellaria longpipes Goldie

Beartooth I.: associated with the following species, *648-62*.

S. subvestita Greene (A-NS)

Beartooth I.: growing in a mat of *Empetrum hermaphroditum* in a burn regeneration, with the previous species, *649-62*. This prairie and foothills species is new to the flora of Saskatchewan. However, it does occur in the Alberta portion of Lake Athabasca (Porsild, 1963). It may be distinguished from *S. longpipes* in the field by its strongly pubescent internodes. Although in *649-62* some of the sepals have fine cilia near the base similar to *S. edwardsii* (*S. ciliatosepala*) Dr. Porsild (pers. corres. 1963) feels that this material better fits his concept of *S. subvestita*.

RANUNCULACEAE

Anemone multifida Poir (LA-S)

Carswell L.: in *Pinus banksiana* woods on limestone ridge, *466-62, 479-62*.

A. parviflora Michx. (LA-S)

Carswell L.: on wet limestone cliff near waterfall, *568-62*. Previously known in Saskatchewan from Tyrrell's collection from the "north shore of Lake Athabasca" (Tyrrell and Dowling, 1896).

Aquilegia brevistyla Hook. (LA-S)

Carswell L.: at base of limestone boulder in *Pinus banksiana* woods, rare, *543-62*.

Caltha palustris L. (NS)

Carswell L.: in marsh on lake edge, *619-62*. This collection represents a locality intermediate between Calumet, Athabasca River, Alberta and Great Slave Lake (H. Raup, 1936).

Ranunculus aquatilis L. var. *capillaceus* (Thuill.) DC. (A-NS)

Carswell L.: lake aquatic in water 2-3 feet deep, sand bottom, *627-62*.

CRUCIFERAE

Arabis holboellii Hornem. var. *retrofracta* (Graham) Rydb. (LA-S)

Carswell L.: in *Pinus banksiana* woods on limestone ridge, *476-62;* on limestone scree slope, *532-62*.

A. lyrata L.

Carswell L.: in *Pinus banksiana* woods on limestone ridge, *475-62;* in *Pinus banksiana* woods on limestone rubble at base of cliff, *464-62, 595-62*.

Barbarea orthoceras Ledeb.

Beartooth I.: on gravel beach at edge of water, uncommon, *654-62*.

Draba cinerea Adams (LA-S)

Carswell L.: on dry south-facing limestone cliff, *492-62;* in limestone rubble at base of cliff, *596-62*. Apparently confined to calcareous habitats in northern Saskatchewan (H. Raup, 1936).

DROSERACEAE

Drosera rotundifolia L.

Carswell L.: on wet sandy soil at edge of *Carex* meadow, associated with *Selaginella*

selaginoides, Tofieldia glutinosa, and *Cladonia coccifera,* 537-62.

SAXIFRAGACEAE

Mitella nuda L. (LA-S)

Carswell L.: in *Picea mariana, Salix* spp. woods in wet drainage area on limestone ridge, *563-62.*

Ribes glandulosum Grauer

Beartooth I.: on old gravel beach, *629-62.*

Saxifraga tricuspidata Rottb.

Carswell L.: in *Pinus banksiana* woods on limestone ridge, *473-62;* on dry south-facing limestone cliff, *483-62.*

ROSACEAE

Amelanchier alnifolia (Nutt.) Nutt.

Carswell L.: in rubble at base of limestone cliff, *594-62.*

Dryas drummondii Richards. (LA-S)

Carswell L.: on wet limestone cliff near waterfall, locally abundant, *567-62.* Apparently confined to limestone or dolomitic rocks in northern Saskatchewan (H. Raup, 1936).

Fragaria virginiana Duch. ssp. *glauca* (Wats.) Staudt (LA-S)

Carswell L.: in *Pinus banksiana* woods on limestone ridge, common, *477-62.*

Potentilla fruticosa L. (NS)

Carswell L.: on boggy lake shore, *525-62.* Not previously known from northern Saskatchewan, but reported by Raup (1936) from Ft. Smith, Alberta.

P. norvegica L.

Carswell L.: in marsh at lake edge, *616-62.* Beartooth I.: on gravel beach at edge of water, *656-62.*

P. palustris (L.) Scop.

Carswell L.: in marsh at lake edge, associated with *Caltha palustris* and *Cicuta mackenzieana, 617-62.*

P. pensylvanica L. (LA-S)

Carswell L.: on dry south-facing limestone cliff, *488-62.*

Prunus pensylvanica L. f.

Beartooth I.: in *Picea glauca* burn regeneration, *650-62;* on old gravel beach, *652-62.*

P. virginiana L. (NS)

Carswell L.: in limestone rubble at base of cliff, *593-62.* Apparently a significant northward extension of the Saskatchewan range of this southern boreal forest–prairie species.

Rosa acicularis Lindl.

Carswell L.: in *Pinus banksiana* woods on limestone cliff, *521-62.*

Rubus idaeus L. var. *canadensis* Richards.

Beartooth I.: on an old gravel beach ridge, *651-62.*

Sorbus scopulina Greene

Beartooth I.: on old gravel beach ridge, uncommon, *653-62.*

EMPETRACEAE

Empetrum hermaphroditum (Lge.) Hagerup

Beartooth I.: forming large mats in sand blowouts, common, *643-62.*

ELAEAGNACEAE

Shepherdia canadensis (L.) Nutt. (LA-S)

Carswell L.: in *Pinus banksiana* woods on limestone ridge, *468-62.*

HALAGORIDACEAE

Hippuris vulgaris L.

Carswell L.: emergent aquatic on lake shore, *625-62.*

UMBELLIFERAE

Cicuta mackenzieana Raup

Carswell L.: in marsh on lake edge, *613-62.*

CORNACEAE

Cornus alba L. ssp. *stolonifera* (Michx.) Wangerin (LA-S)

Carswell L.: in limestone rubble at base of cliff, *592-62.* Previously known in northern Saskatchewan from one locality on the north shore of Lake Athabasca (H. Raup, 1936).

PYROLACEAE

Pyrola asarifolia Michx. var. *purpurea* (Bunge) Fern.

Carswell L.: on boggy edge of pond, associated with *Betula glandulosa* and *Salix candida, 526-62A.*

ERICACEAE

Arctostaphylos uva-ursi (L.) Spreng.

Observed in *Pinus banksiana* woods at Carswell Lake.

Ledum groenlandicum Oeder

Observed at Carswell Lake in *Picea mariana* muskeg and on Beartooth Island in *Picea glauca* burn regeneration.

Vaccinium myrtilloides Michx.

Observed in *Pinus banksiana* woods at Carswell Lake.

PRIMULACEAE

Androsace septentrionalis L. (LA-S)

Carswell L.: on dry south-facing limestone cliff, *487-62.* Previously known from one locality on the north shore of Lake Athabasca (H. Raup, 1936).

LABIATAE

Moldavica parviflora (Nutt.) Britt. (LA-S)
Carswell L.: on limestone scree slope, *531-62*. Previously known in northern Saskatchewan from one locality on the north shore of Lake Athabasca, as *Dracocephalum parviflorum* Nutt. (H. Raup, 1936).
Scutellaria galericulata L. (A-NS)
Carswell L.: in marsh on lake edge, *614-62*.

SCROPHULARIACEAE

Melampyrum lineare Desv.
Carswell L.: on wet sandy soil at edge of *Carex* meadow, *535-62*.

RUBIACEAE

Galium septentrionale R. & S. (*G. boreale* of authors) (A-NS)
Carswell L.: on dry south-facing slope of limestone cliff, *494-62*.

CAPRIFOLIACEAE

Lonicera dioica L. var. *glaucescens* (Rydb.) Butters. (LA-S)
Carswell L.: on limestone outcrop, *527-62*.

CAMPANULACEAE

Campanula rotundifolia L.
Carswell L.: in *Pinus banksiana* woods on limestone ridge, common, *474-62*.

LOBELIACEAE

Lobelia dortmanna L. (NS)
Carswell L.: emergent aquatic in sand on lake edge, water 2-3 feet deep, only basal leaves collected in 1962, *626-62*. The identity of this vegetative collection was later verified by collections made in 1963 at Little Gull Lake, about 30 miles northward. This collection represents the second report of this principally eastern species in Saskatchewan, the other is from Windrum Lake, appr. lat. 56° 02′ N., long. 104° (Breitung, 1957).

COMPOSITAE

Determined or verified by Dr. A. Cronquist.
Achillea millifolium L. var. *nigrescens* Meyer (A-NS)
Carswell L.: in *Pinus banksiana* woods on limestone ridge, *471-62, 528-62*.
Antennaria pulcherrima (Hook.) Greene (NS)
Carswell L.: at edge of *Carex* meadow, *560-62*. This record fills a gap in the distribution of this species between Wood Buffalo Park (H. Raup, 1935) and McKague, Saskatchewan (Breitung, 1957).
A. rosea (D. C. Eaton) Greene (LA-S)
Carswell L.: in *Pinus banksiana* woods on limestone ridge, *469-62*.
Artemisia campestris L. ssp. *borealis* (Pall.) Hall & Clements
Carswell L.: on dry south-facing limestone cliff, *491-62*.
Aster junciformis Rydb. (A-NS)
Carswell L.: on wet limestone cliff near waterfall, *569-62;* on wet sand at edge of *Carex* meadow, *534-62*.
Erigeron compositus Pursh var. *discoideus* Gray (*E. trifidus* Hook.) (NS)
Carswell L.: on dry south-facing limestone cliff, uncommon, *486-62*. This represents a southward extension of this taxon from Great Slave Lake (H. Raup, 1936).
E. glabellus Nutt. (NS)
Carswell L.: in *Pinus banksiana* woods on limestone ridge, *478-62*. Apparently the only record of this species between Rocky Lake, Manitoba, 70 miles north of The Pas (Scoggan, 1957) and Wood Buffalo Park, Alberta (H. Raup, 1935).
E. hyssopifolius Michx.
Carswell L.: on limestone outcrop, *529-62*.
Petasites frigidus (L.) Fries var. *palmatus* (Ait.) Cronq.
Carswell L.: in *Picea mariana, Salix* spp. woods in wet drainage area on limestone ridge, *565-62*.
P. sagittatus (Pursh) Gray (LA-S)
Carswell L.: with the preceding, *562-62*.
Senecio streptanthifolius Greene (LA-S)
Carswell L.: in *Pinus banksiana* woods on sandy limestone rubble, *465-62;* in similar woods on limestone ridge, *472-62*.
Solidago hispida Muhl. (NS)
Carswell L.: on limestone scree slope, uncommon, *533-62*. A northern extension of the range of this principally southern species.

Musci

Genera arranged in alphabetical order.
Identified by Dr. H. Crum.

Abietinella abietina (Hedw.) Fleisch.
Carswell L.: on limestone boulders in *Pinus banksiana, Populus tremuloides* woods, *581-62A, 589-62*.

Amblystigiella sprucei (Bruch) Loeske (*A. jungermannioides* (Brid.) Giac.) (NS)
Carswell L.: with the preceding, *584-62*. New to the flora of Saskatchewan.
Brachythecium salebrosum (Web. & Mohr) B.S.G. (NS)
Carswell L.: with the preceding, *587-62*. Not previously known in Saskatchewan north of latitude 56° (Conard, 1957).
Bryoerythrophyllum recurvirostrum (Hedw.) Chen (NS)
Carswell L.: with the preceding, *586-62*. Not previously known in Saskatchewan north of latitude 56° (Conard, 1957).
Bryum lacustre Bland (NS)
Beartooth I.: in wet clay slump below *Picea mariana* muskeg, *657-62*. New to the flora of Saskatchewan.
B. pseudotriquetrum (Hedw.) Schwaegr. (NS)
Carswell L.: on wet limestone cliff near waterfall, *574-62A*. Not previously known in Saskatchewan north of latitude 55° (Conard, 1957).
Campylium stellatum (Hedw.) Jens. (NS)
Carswell L.: with the preceding, *574-62A*. Not previously known in Saskatchewan north of latitude 56° (Conard, 1957).
Cinclidium stygium Sw. (NS)
Carswell L.: with the preceding, *574-62B*. New to northern Saskatchewan.
Dicranum rugosum Brid.
Carswell L.: on limestone boulders in *Pinus banksiana, Populus tremuloides* woods, *580-62A*.
Distichium capillaceum (Hedw.) B.S.G.
Carswell L.: with the preceding, *577-62*.
Ditrichum flexicaule (Schwaegr.) Hampe (NS)
Carswell L.: with the preceding, *587-62, 588-62A*. New to the flora of Saskatchewan.
Encalypta procera Bruch (NS)
Carswell L.: with the preceding, *587-62, 584-62*. New to the flora of Saskatchewan.
E. vulgaris Hedw. (NS)
Carswell L.: with the preceding, *577-62*. New to the flora of Saskatchewan.
Grimmia apocarpa Hedw. var. *stricta* (Turn.) Hook. & Tayl. (NS)
Carswell L.: with the preceding, *588-62B*. New to the flora of Saskatchewan.
Hypnum cupressiforme Hedw. (NS)
Carswell L.: with the preceding, *576-62, 581-62B, 583-62, 612-62*. Not previously known in Saskatchewan north of latitude 56° (Conard, 1957).
H. fastigiatum Brid. (NS)
Carswell L.: with the preceding, *587-62*. New to the flora of Saskatchewan.
Neckera pennata Hedw.
Carswell L.: with the preceding, *578-62*.
Orthotrichum anomalum Hedw.
Carswell L.: with the preceding, *579-62*.
Pleurozium schreberi (Brid.) Mitt.
Carswell L.: with the preceding, *580-62B;* in wet *Picea mariana, Salix* spp. woods on limestone ridge, *566-62*.
Rhytidium rugosum (Hedw.) Kindb. (NS)
Carswell L.: on limestone boulders in *Pinus banksiana, Populus tremuloides* woods, *589-62*. New to the flora of Saskatchewan.
Tortella tortuosa (Hedw.) Limpr. (NS)
Carswell L.: with the preceding, *585-62*. New to the flora of Saskatchewan.
Tortula ruralis (Hedw.) Crome (NS)
Carswell L.: with the preceding, *581-62B*. New to the flora of Saskatchewan.

Lichenes

Genera arranged in alphabetical order.
Identified by Dr. M. Hale and by Dr. J. W. Thompson.

Caloplaca elegans (Link.) Th. Fr.
Carswell L.: on dry south-facing limestone cliff, *603-62A, 603-62C, 603-62D;* with *Physcia sciastra, 603-62B*.
Candelariella vitellina (Ehrh.) Müll. Arg.
Beartooth I.: on beach cobbles, *647-62E*.
Cladonia amaurocrea (Flk.) Schaer.
Carswell L.: on limestone boulder in *Pinus banksiana, Populus tremuloides* woods, *582-62*.
C. coccifera (L.) Willd.
Carswell L.: in wet sandy soil at edge of *Carex* meadow, *539-62*.
Dermatocarpon miniatum (L.) Mann. (A-NS)
Carswell L.: on dry south-facing limestone cliff, *600-62*.
New to the flora of Saskatchewan.
Lecanora melanophthalma (DC.) Ram. (NS)
Beartooth I.: on beach cobbles, with *Lecanora polytropa, Rhizocarpon disporum, R. geographicum,* and *Umbilicaria hyperborea, 647-62B*.
New to the flora of Saskatchewan.
Lecanora polytropa (Ehrh.) Rabenh. (NS)
Beartooth I.: on beach cobbles, with *Leca-*

nora melanophthalma, *Rhizocarpon disporum*, *R. geographicum*, and *Umbilicaria hyperborea*, *647-62B*.
New to the flora of Saskatchewan.

Lecidea rubiformis Wahl. (NS)
Carswell L.: on dry south-facing limestone cliff, *599-62*.
New to the flora of Saskatchewan.

Parmelia centrifuga (L.) Ach.
Beartooth I.: on beach cobbles, *647-62D*.

P. conspersa (Ach.) Ach. (A-NS)
Beartooth I.: on beach cobbles, *647-62J*.
New to the flora of Saskatchewan.

P. lineola Berry (NS)
Beartooth I.: on beach cobbles, *647-62K*.
New to the flora of Saskatchewan.

Physcia muscigena (Ach.) Nyl. (NS)
Carswell L.: on dry south-facing limestone cliff, *601-62*.
New to the flora of Saskatchewan.

P. sciastra (Ach.) Du Rietz (NS)
Carswell L.: on limestone cliff, with *Caloplaca elegans*, *603-62B*.
New to the flora of Saskatchewan.

Ramalina intermedia Nyl. (NS)
Beartooth I.: on beach cobbles, *647-62F*.
New to the flora of Saskatchewan.

Rhizocarpon disporum (Naeg.) Müll. Arg. (NS)
Beartooth I.: on beach cobbles, with *Rhizocarpon geographicum*, *Lecanora melanophthalma*, *L. polytropa*, and *Umbilicaria hyperborea*, *647-62B*.
New to the flora of Saskatchewan.

R. geographicum (L.) DC. (NS)
Beartooth I.: with the preceding and associated with the same species, *647-62B*.
New to the flora of Saskatchewan.

R. obscuratum (Ach.) Mass.
Beartooth I.: on beach cobbles, *647-62C*.

Umbilicaria hyperborea (Ach.) Hoffm.
Beartooth I.: on beach cobbles, with *Lecanora melanophthalma*, *L. polytropa*, *Rhizocarpon disporum*, and *R. geographicum*, *647-62B*.

Xanthoria candelaria (L.) Arn.
Beartooth I.: on beach cobbles, *647-62G*.

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SOME INTERESTING PLANT RECORDS FROM THE CHALK RIVER DISTRICT, ONTARIO*

T. C. Brayshaw
Forest Research Branch, Forest Experiment Station, Chalk River, Ontario

While collecting in the Chalk River area during the past few years, the author has found several species growing beyond their previously known range limits. Some of these are obviously recent arrivals which have followed railways or roads into the district, but others are undoubtedly naturally occurring species that hitherto have gone unrecorded.

The following species are considered worthy of note and are treated in detail below:

Isoëtes macrospora Dur.
Dryopteris fragrans (L.) Schott var. *remotiuscula* Komarov
Juniperus virginiana L. var. *crebra* Fern. & Griscom
Najas gracillima (A. Br.) Magnus
Butomus umbellatus L.
Panicum virgatum L.
Epipactis Helleborine (L.) Crantz
Thalictrum venulosum Trel.
Saxifraga Aizoon Jacq. var. *neoqaea* Butters
Potentilla Hippiana Lehm.
P. gracilis Dougl. var. *pulcherrima* (Lehm.) Fern.
P. rivalis Nutt. var. *millegrana* (Engelm.) S. Wats.
Rhus aromatica Ait.
Cephalanthus occidentalis L.

In citing herbarium specimens, the herbaria in which they are located are indicated by their codes, as follows:

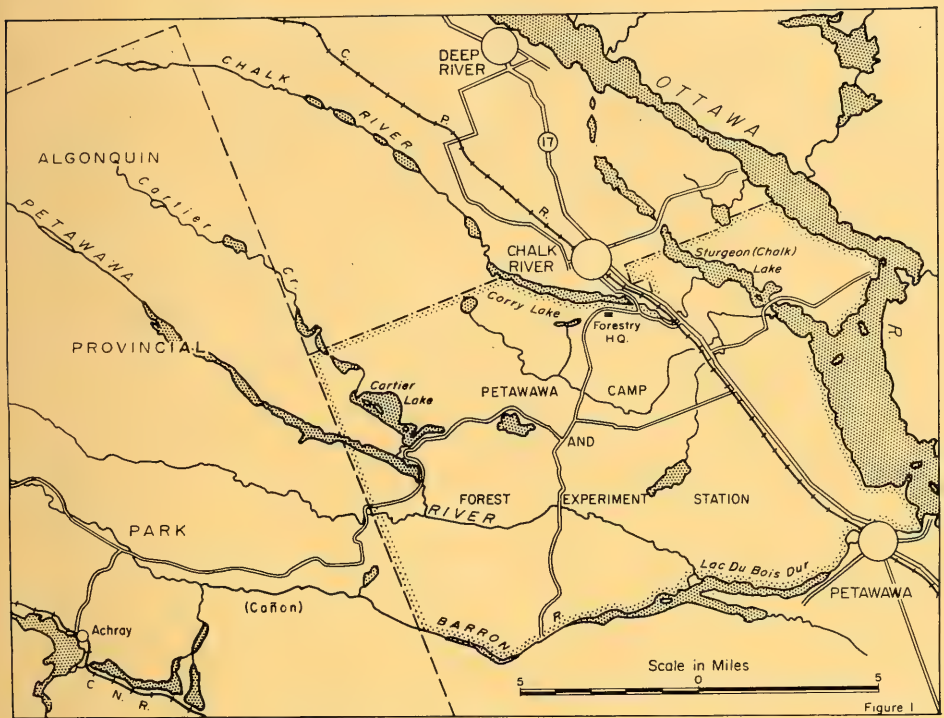
CAN National Museum of Canada, Ottawa.
DAO Plant Research Institute, Central Experimental Farm, Ottawa.
PFES Petawawa Forest Experiment Station, Chalk River, Ontario.
TRT Department of Botany, University of Toronto, Toronto, Ont.

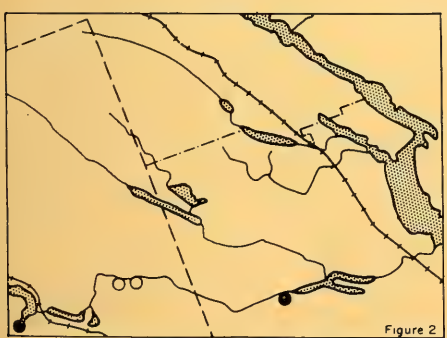
The area within which most of these records occur is indicated in Figure 1. Figures 2 and 3 show the distributions of two species; in these maps, solid spots indicate the sites of collections and open circles sight reports only.

Isoëtes macrospora Dur.

This species of quillwort is distinguished from the locally common *Isoëtes riparia* Engelm. by its larger megaspores (0.6-0.8 mm diameter) with low-crested reticulate ridges and its short, broadly deltoid ligule. It has been found at only one locality in the district: King Point on the Ottawa River near Chalk River. It occurs in water with a silty bottom, in company with *I. riparia* and *I. muricata* Dur. It probably would not have been found but for the fact that at the time of collection, the river level, lower than at any time in the past fifty years, permitted the discovery of plants that are normally covered by several feet of water.

*Department of Forestry, Canada, Forest Research Branch Contribution No. 629





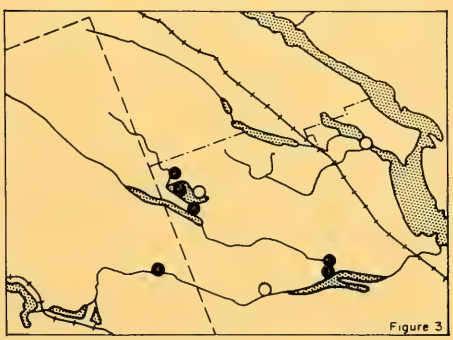


FIGURE 1. Map of the Chalk River district (top).

FIGURE 2. Distribution of *Dryopteris fragrans* var. *remotiuscula* in the Chalk River district (bottom, left).

FIGURE 3. Distribution of *Cephalanthus occidentalis* in the Chalk River District (bottom, right).

In Canada, *I. macrospora* is widely distributed along the Atlantic seaboard, in Quebec, the Maritime Provinces and Newfoundland; but it is occasionally present further inland, as records from Amos and Senneterre in the eastern Clay Belt region of Quebec indicate. It is also known from inland regions of the eastern United States. So far as the writer is aware, this is the first record of the species in Ontario. However, its pre-

sently known distribution suggests that it may be found in other parts of the province.

Specimen *4470* has been examined by Dr. B. Boivin of the Plant Research Institute, Ottawa, who has confirmed the identity. Specimen *4425* is similar, but with the immature megaspores only 0.5-0.6 mm in diameter.

Specimens: King Point, Chalk River, Ontario, 2 September 1962, Brayshaw (PFES *4470*); King Point, August 1962, Brayshaw (PFES *4425*).

Dryopteris fragrans (L.) Schott var. *remotiuscula* Komarov

This arctic and subarctic fern, known from a number of points on the north shore of Lake Superior, the Gulf of St. Lawrence and further north, has been collected at two localities and sighted at two others in this district. All the plants found so far are in the valley of the Barron River (see Figure 2) growing on vertical or near-vertical north-facing cliffs overlooking water. These are naturally cool habitats, seldom if ever receiving direct sunlight. It may or may not be significant with regard to the palatability of this species to deer that all plants found are above a conspicuous browse-line that follows the shores here.

The local occurrence of this fern is no doubt a function both of its ecological requirements and of the history of the area. The Barron River, at present a clear stream with a small flow volume, runs for several miles through a series of gorges cut into the Precambrian Shield to a maximum depth of about 400 feet, with long deep still reaches through the depths of the gorges. In its present form this river is obviously incapable of eroding such a formation. This fact, together with the disjunct occurrences of at least two plants of generally more northern distribution (see also under *Saxifraga Aizoon*), suggests that possibly in the late Pleistocene Epoch (while the ice still covered the Ottawa and Petawawa River valleys to the north) the Barron carried the main discharge of water from the land to the west, and possibly even from the upper Great Lakes.

In addition to the two collections cited below, the species has been observed without collection at two points in the Barron River Cañon (the deepest part of the series of gorges, just above the point where the river leaves Algonquin Park). One of these sites is close to the station for *Saxifraga Aizoon*.

Specimens: S bank of Barron R., 2 miles E of Barron River road, 13 October 1961, Brayshaw (PFES *3909*); S shore of Carcajou Bay, Achray, Algonquin Park (with isolated colony of *Alnus crispa*), 7 July 1962, Brayshaw (PFES *4187*).

Juniperus virginiana L. var *crebra* Fern. & Griscom

The previously known northern limit of red juniper in this part of the country was at Deacon, near Killaloe, in the Bonnechere Valley. However, it has recently been found at two localities near Chalk River.

On ledges on the vertical south-facing cliffs of Oiseau Rock overlooking the Ottawa River, several trees (some with fruit) up to 25 feet tall have been found. This site is an isolated, warm, dry, sunny habitat, where the trees obviously form a permanent stand. However, the second locality is in a red pine plantation on the Petawawa Forest Experiment Station, where the junipers must have arrived fairly recently. One of the two very stunted bushes found there showed clear signs of having been repeatedly browsed; although the plant was only some two feet high, a low branch from it was found to be 10 years old. The plants probably originated from seeds carried by birds from the Oiseau Rock stand, five miles ENE of this site.

Specimens: Oiseau Rock, Chalk River, 18 July 1961, Brayshaw and Van Wagner (PFES *3486*; duplicate in TRT). Two miles E of Chalk River, 1 November 1961, Mayo & Brayshaw (PFS *3745*).

Najas gracillima (A. Br.) Magnus

Though this species is reported from much of the eastern United States, in Canada it has previously been collected only in Nova Scotia. Its discovery near Chalk River is, so far as the author is aware, the first record for Ontario.

It is present in two rivers, the Barron and Chalk, and also in Corry Lake (on the Chalk River). In these waters it is not uncommon, occurring mixed with the more widely distributed *N. flexilis* (Willd.) Rostk. and Schmidt. *N. gracillima* can be distinguished from *N. flexilis* at sight by its more diffuse appearance, caused largely by its significantly narrower and more thread-like leaves. The

wider leaves of *N. flexilis* produce an overall greener, denser foliage which hides objects beyond it; whereas such objects are generally visible through a plant of *N. gracillima*.

Specimens: The Canadian records of *N. gracillima* known to the author are as follows: NOVA SCOTIA: Charlotte Lake, Queens Co., 16 August 1954, E. C. Smith *et al. 12345* (CAN); Cameron Lake, Hants Co., 18 August 1954, E. C. Smith *et al. 12500* (CAN); ONTARIO: Corry Lake, Chalk River, 5 September 1958; Brayshaw (PFES *213*); same locality, 30 August 1962, Brayshaw (PFES *4466*); Chalk R. above Corry L., 3 September 1962, Brayshaw (PFES *4478*, specimen now in DAO); Barron River at Brigham Chute, Algonquin Park, 8 September 1962, Brayshaw (PFES *4491*).

Butomus umbellatus L.

The flowering rush, a European marsh plant first established near Montreal, has now extended its range up the Ottawa River as far as Pembroke. It was first seen there by the author in 1958, but was not collected until 1962. It grows on a marshy shore at the mouth of Indian River, accompanied by *Sparganium eurycarpum, Scirpus fluviatilis* and *Iris pseudacorus*.

Specimen: Pembroke, 14 July 1962, Brayshaw (PFES *4337*).

Epipactis Helleborine (L.) Crantz

This, the only European orchid to become established wild in this country, has recently been found in the district. In 1961 it was found in an old clearing a mile south of the Forest Experiment Station Headquarters.

Specimen: Chalk River, Petawawa Forest Experiment Station, 29 August 1961, Brayshaw (PFES *3579*).

Panicum virgatum L.

Known from the St. Lawrence Valley and Great Lakes region in southern Ontario, this grass has recently arrived in the Chalk River district by rail. It was found on the embankment of the Canadian Pacific Railway some three miles SE of Chalk River. So far as it is known to the author, this is its first recorded appearance in the Ottawa Valley.

Specimen: Chalk River, 29 August 1961, Brayshaw (PFES *3604*).

Thalictrum venulosum Trel.

This subarctic and prairie meadow-rue has not previously been reported from the southern half of Ontario. It has established itself in a small but spreading colony on the railway embankment not far from the above-mentioned site for *Panicum virgatum* and undoubtedly has entered the district by the same means.

Specimen: Chalk River, 16 August 1961, Brayshaw (PFES *4506*).

Saxifraga Aizoon Jacq. var. *neogaea* Butters

The presence of this unexpected saxifrage in the district was first drawn to the author's attention by the late Dr. A. M. Moore of Deep River. A calciphilous plant of arctic distribution, *S. Aizoon* grows in this area in two small colonies on near-vertical north-facing cliffs in the gorge of the Barron River in Algonquin Park. The rocks are non-calcareous, but the presence of a white limy surface deposit on south-facing cliffs farther down the gorge suggests that lime-bearing seepage-water must be the source of calcium for these plants. *Dryopteris fragrans* has been seen close to one of the colonies of this saxifrage.

Specimen: S. bank of Barron River cañon, Algonquin Park, 2 July 1962, Brayshaw (PFES *4139*).

Potentilla Hippiana Lehm. and *P. gracilis* Dougl. var. *pulcherrima* (Lehm.) Fern.

Both these species are native to the Great Plains region from Minnesota westward (*P. Hippiana* is also known from northern Michigan). Both have been found by Mrs. M. I. Moore, growing within a few yards of each other in an old pasture south of Deep River. Their locality suggests introduction in imported hay. This probably occurred many years ago, since the pasture is now largely overgrown with bush and does not appear to have been in regular use for a long time.

Specimen: *P. Hippiana*: Wylie Road, Deep River, M. I. Moore (PFES *3600*); *P. gracilis* var. *pulcherrima*: Wylie Road, Deep River, M. I. Moore (PFES *3601*).

Potentilla rivalis Nutt. var. *millegrana* (Engelm.) S. Wats.

The finding of this species in the forest here marks a considerable eastward extension of its known range, since it has not previously been recorded east of Sault Ste. Marie.

Specimen: Maunsell Lake, Chalk River, 16 July 1957, Brayshaw (PFES *2138*).

Rhus aromatica Ait.

This low shrub which is distributed around the shores of the Great Lakes and along the southern fringe of the Canadian Shield, with an isolated population in the Ottawa district, has not previously been recorded from further up the Ottawa Valley than Pontiac Station, 30 miles west of Hull. It is present at the First Chute on the Barron River at the southern boundary of the Petawawa Forest Experiment Station. Only one small clump has been found at this locality, but Mrs. M. I. Moore has recently shown the writer a specimen collected on Oiseau Rock.

Specimen: Barron River at First Chute, Petawawa Forest Experiment Station, 3 September 1961, Brayshaw (PFES *3615*; duplicate in TRT).

Cephalanthus occidentalis L.

Already known from the Barron River, this marsh-inhabiting shrub has been found at several points in the valley of the Petawawa River which joins the Barron in Lac du Bois Dur near Petawawa. In addition to the points on the Petawawa River, buttonbush has been found at a few places around the shore of Cartier Lake and along Cartier Creek, the highest and northernmost locality so far being on the creek just below the outlet of Moosegrove Lake, half a mile above the head of Cartier Lake. This point is about eight miles north of the previously recorded station on the Barron River (see Figure 3). It should be looked for along the upper reaches of the Petawawa River.

Dr. D. A. Fraser of this Station informs me that he recently saw, but did not collect, a plant on an island in the eastern end of Sturgeon (Chalk) Lake, about five miles ESE of Chalk River village.

Specimens: Petawawa River below Half-mile Rapid, 2 September 1961, Brayshaw (PFES *3617*); rocky island in Cartier Lake, 6 October 1960, Brayshaw (PFES *3205*); Cartier Creek below Moosegrove Lake, Petawawa Forest Experiment Station, 20 October 1962, Brayshaw (PFES *4509*).

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NOTES ON THE AMPHIBIANS OF BROWNS FLAT AREA, NEW BRUNSWICK

STANLEY W. GORHAM
National Museum of Canada, Ottawa, Ontario

THE FOLLOWING NOTES, most of which were made during the years 1948-1953, deal with the amphibians of the Browns Flat area, Kings County, New Brunswick. The Browns Flat area here defined (Figure 1) includes the village itself and the area for 10 miles along the western shores of the Saint John River from Victoria Creek, near Greenwich Hill, northeast to the most northeasterly part of Oak Point village. The average width of this area, between the river and the Kings-Queens County line, is two to four miles. The area is about 15 miles due north of the city of Saint John.

The Browns Flat area is a rather hilly and rolling region of the southern Saint John River valley. The greater portion of the cleared land is within a mile of the river; the remainder of the area has a heavy softwood growth with a hardwood growth on the ridges. The greatest elevation is Mount Serjeant (1000 feet), three miles northwest of Browns Flat village.

FIGURE 1. Map of Browns Flat Area

There are three main drainage systems in this area emptying into the Saint John River: Devils Back Brook at Victoria Creek, near Greenwich Hill village; Jones Creek Brook at Jones Creek, near Central Greenwich village; Flaglor Brook at Marley Creek, approximately one-half mile southwest of Oak Point. There are also numerous smaller spring-fed brooks which empty directly into the Saint John River. There are six lakes in the area and many

ponds, bogs and swamps. Clark Lake, three-quarters of a mile in length, is the largest lake. The ice is generally out of the lakes by the last week of April but it may be out as early as April 10, or as late as May 5.

The greatest width of the Saint John River within this area is about one and one-half miles. There are five islands: Catons Island, near Browns Flat and Glenwood, is about one mile in length and mainly wooded; Rocky Island and Isle of Pines, opposite Glenwood and Central Greenwich, are connected by intervale land but are in themselves mainly wooded; Rush Island, one-quarter mile south of Oak Point, is a low grassy island which is underwater during the spring freshet; Grassy Island, opposite Oak Point village, is approximately three-quarters of a mile in length and is a low grassy island which is usually covered by water during the spring freshet. The river level raises as high as twelve to fifteen feet during April and May.

My interest in amphibians has always been keen but it was Mr. W. Austin Squires, Curator of Natural Science Department, New Brunswick Museum, who impressed upon me the importance of keeping notes in regard to early spring appearance of amphibians. Mr. Squires also supplied me with a manuscript checklist of the amphibians (also reptiles, birds and mammals) of New Brunswick. From 1953 to 1957 Dr. J. Sherman Bleakney, Curator of Herpetology, National Museum of Canada was always willing to help me with my queries regarding the amphibians of New Brunswick. Mr. Francis R. Cook, the present Curator of Herpetology at the National Museum of Canada, has helped me in every way possible with my inquiries regarding New Brunswick amphibians. Through the courtesy of Dr. W. B. Scott I was allowed to examine the New Brunswick amphibian specimens in the collection of the Royal Ontario Museum, Toronto.

Ambystoma maculatum, SPOTTED SALAMANDER (local name—yellow-spotted lizard)

This species was most commonly seen during the spring when the adults travelled to the breeding ponds and ditches. The roadside ditches along both the main and secondary roads, railway ditches and meadow and woodland ponds were very good spots to observe the Spotted Salamander at that time of year. On an early morning (April 1950) after a night's rain and over a distance of one mile of main highway, I counted twenty Spotted Salamanders which had been killed by automobiles. My notes for the first spring appearance are April 3, 1948; April 4, 1949; April 5, 1950; April 3, 1951. In the fall I have seen Spotted Salamanders on several occasions under logs, but never in ponds, as late as October 19, 1950 and October 11, 1951.

Ambystoma laterale, BLUE-SPOTTED SALAMANDER (local names — blue-spotted lizard, black lizard, big lizard)

New Brunswick material formerly referred to *Ambystoma jeffersonianum* in the National Museum of Canada has been identified as *Ambystoma laterale* by Thomas M. Uzzell, Jr. This species was found in the spring in a similar habitat as the Spotted Salamander but sometimes frequented shallower ditches. A good collecting spot in early April was at Oak Point in a roadside ditch where the main highway crosses the railway track, another was the railway ditch near Grandview station at Browns Flat. Whether this species was as plentiful as the Spotted Salamander I cannot say; however, over a mile of road during the April morning when twenty dead Spotted Salamanders were picked up, I could not find a single Blue-spotted Salamander. One of the earliest appearance dates was April 9, 1953. Other dates are from April 15 to the end of April. During the summer months I have taken Blue-spotted Salamanders under wood piles. November 5, 1950 is the latest record I have and this was a half-grown specimen.

Notophthalmus viridescens, RED-SPOTTED NEWT (local names — red lizard, green lizard, trout lizard)

The adults of this species were fairly common at Browns Flat during the latter part of April and early May where they could be found in muddy woodland ponds and shallow lakes. In late April, I saw Red-spotted Newts in the railway ditch at approximately one mile above Victoria Station and in Galilee Lake (artificial) at Browns Flat, also at Clark Lake in the shallow muddy waters near the outlet. Red-spotted Newts could usually be observed during the summer along the shallower edges of Lily Lake, Browns Flat. The red eft or immature of this species could often be found under woodpiles or slabs of wood during the summer. The earliest appearance date for the red eft was May 15, 1955 when a specimen was found in a rotted log while I was looking for Red-backed Salamanders. The latest date the Red-spotted Newt was observed in ponds was October 20, 1951.

Desmognathus fuscus, DUSKY SALAMANDER (local names — spring lizard, black lizard, brook lizard, well lizard)

This is a common salamander of wells, springs and spring-fed brooks. I have taken Dusky Salamanders and Two-lined Salamanders under the same stone only a few inches apart. However, certain habitats where the Two-lined Salamanders are collected, for example, large permanent streams which are not spring-fed, one is not likely to find the Dusky Salamander. The spring appearance of this species was May 2, 1951 and April 20, 1952. The Dusky Salamander was most plentiful during the months of June, July, August and early September and was found in decreasing numbers up until November. I have seen Dusky Salamanders dug from the bottom of cold springs in early December.

Eurycea bislineata, TWO-LINED SALAMANDER (local names — brook lizard, brown lizard)

This was a common salamander of the large permanent gravelly and rock bottom brooks and streams. They also frequented smaller brooks which were spring-fed. I collected Two-lined Salamanders in the Devils Back Brook during early May. It was very common during the months of June and early July in the spring-fed Lindsay Brook (too small to be included on map) about one-third mile from Browns Flat centre. The Two-lined Salamander was most common in June, early July and September and in varying numbers during the latter part of July, August and early October.

Plethodon cinereus, RED-BACKED SALAMANDER (local names — red-back lizard, wood lizard)

The Red-backed Salamander was very common in the wooded swamps (mostly cedar, some black spruce) during the late spring and summer where they could be found in partly rotted fallen trees and stumps. On May 15, 1955, I collected them in partly rotted logs in a cedar swamp approximately one mile north of Browns Flat centre. In addition I have one report of this salamander in late April 1953 when it was found in a rotted log. During the last week of July 1956 I took a specimen from under a partly submerged stone in a brook while collecting Two-lined Salamanders two miles southwest of Browns Flat. In the middle of August 1958, about one mile north of Browns Flat centre, Red-backed Salamander eggs were found in a partly rotted cedar log. This salamander was not commonly collected after the heavy frosts of mid-October but individuals have been taken in early November under rotted cedar logs in a swamp.

Bufo americanus, AMERICAN TOAD (local name — toad)

This was probably the best known of the amphibians in Browns Flat area. They could be heard calling in late April, May and early June in most roadside ditches and ponds. The earliest calling dates were May 1, 1950 and April 30, 1951. The latest date I have heard an American Toad calling from a breeding pond was on July 30, 1952. On May 1, 1951, I observed an American Toad in a small burrow where it had apparently spent the winter. The burrow was on a bare section of a side hill which had been covered by snow until quite recently. The toad had apparently picked a spot where there was little danger of frost penetration as small potatoes which were left in the ground at this spot the previous fall were untouched by frost and sprouted later. This showed a frost penetration of not more than four to six inches. As the weather remained quite cool it was usually only in the afternoons that the toad would have its head out of the burrow getting the sun. It appeared to be a

male. Each day I visited the burrow and it was not until May 25 after a heavy rain that the toad disappeared. I examined the burrow and it was about six to eight inches in depth. On July 2, 1952, after a month's drought, many recently transformed and transforming American Toads were observed on the edge of a drying pool. They were so small that they were being picked up by Chipping Sparrows. Adult American Toads were observed in varying numbers until the end of October and the first week in November, usually under stones or rotted logs and wood.

Hyla crucifer, SPRING PEEPER (local name — peeper)

This small amphibian was very common in the meadow and woodland ponds and roadside ditches in the spring from the middle of April onward. It was heard calling on April 19, 1950, April 6, 1951 and April 10, 1952. Spring Peepers were picked up dead on the highway road on April 4, 1951 and April 7, 1952. The latest date I have heard a Spring Peeper calling from a breeding pond was July 12, 1951. The chorus is usually over by late June. On July 19, 1956, transformed and transforming Spring Peepers were collected, some still had their tails and had climbed up in the bushes which bordered the edge of a pond. In August, September and October I heard individual Spring Peepers calling from trees, particularly before a shower or rainstorm. On November 15, 1949, it was very mild and Spring Peepers were calling occasionally from trees. On October 1-18, 1950 individual Spring Peepers were heard calling from trees. October 22, 1950, was extremely cold — one of the coldest days on record for that date — with several inches of snow. November 17, 1950, the weather was mild and Spring Peepers were heard calling from trees. December 12, 1950, was very mild with a temperature of 60°F.; a single Spring Peeper was heard calling from a bush very low to the ground or on the ground but it could not be located. On November 1, 1951, the weather was cold and Spring Peepers were not heard after that date.

Rana sylvatica, WOOD FROG (local name — brown frog)

This frog was an early spring caller at Browns Flat and was commonly found in woodland ponds as well as ditches and ponds bordering woodlands. Early spring appearance was noted on April 9, 1949; April 19, 1950; April 10, 1952 and April 9, 1953. Calling lasts until mid-May. During the summer adults were often seen in damp woodland areas. On November 17, 1949, a Wood Frog was heard calling from the edge of a pond. On November 17, 1950 a Wood Frog was heard calling from a damp section of an apple orchard but it could not be located. On November 27, 1950, a Wood Frog was heard calling and was located in leaves under a maple tree. On December 3, 1950, it was mild and a Wood Frog was heard calling and was located in leaves only a short distance from the tree where the November 27 frog was observed. This frog was smaller than the one seen on November 27.

Rana pipiens, LEOPARD FROG (local names — spotted frog, meadow frog)

This species was common around the end of April and early May where they were heard calling from ponds, ditches and along the shores of lakes. On May 6, 1949, and April 30, 1950, they were heard calling. The Leopard Frog called until mid-June although the main chorus was usually over by the end of May. During the summer months they are numerous in the meadowlands and occasionally they were seen in this habitat until the end of October. On October 23, 1949, a Leopard Frog was observed in the water at Grassy Island in the Saint John River opposite Oak Point. Grassy Island is about one-third of a mile from the nearest mainland. There is a fifteen inch rise and fall of tide in the river at Oak Point during the summer and early autumn, with slightly less rise and fall of tide if the autumn rains have been heavy. During the summer when the river is low the water is known to be slightly brackish, although never to the point where it is unfit for cattle to drink.

Rana palustris, PICKEREL FROG (local name — spotted frog)

During the spring this species may be found in ponds, roadside ditches and lakes. In the breeding season they are considerably more plentiful in lakes than the Leopard Frogs. I have heard Pickerel Frogs calling in late April from ponds and roadside ditches but the main chorus is to be heard in May from the larger ponds and lakes. When Leopard Frogs and Pickerel Frogs were calling from the same habitat

it was somewhat difficult to distinguish the call. Early spring calling was noted on April 29, 1950, from a roadside ditch. On April 3, 1952, a live adult Pickerel Frog was found in a well. During the haying season of July and August I have seen adult Pickerel Frogs in the hayfield, although in not as large numbers as the Leopard Frogs. By late August and early September I have seen hundreds of young Pickerel Frogs on the bogs near Lily Lake, Browns Flat and at Clark Lake, north of Oak Point. On November 28, 1950, an adult Pickerel Frog was found in a cold spring. On January 18, 1951, three adult Pickerel Frogs were found dead in a cold spring where they had apparently been hibernating.

Rana clamitans, GREEN FROG (local names — green frog, bullfrog)

This species was common in the ponds, ditches and springs during the spring, summer and fall. On March 27, 1954 I took a Green Frog from under a slab of wood in a ditch about a mile north of Browns Flat. Snow was still on both sides of the ditch so the frog had apparently spent the winter there. Green Frogs called from late April until mid-June but the main chorus ends around the latter part of May. During the haying season I have seen half-grown Green Frogs in the damp sections of meadowlands. Green Frogs, both adult and juvenile, have been observed around springs in early November.

Rana catesbeiana, BULLFROG (local name — bullfrog)

This species is common in the lakes and larger ponds during the latter part of the spring and summer months. I have also taken both half-grown and adult Bullfrogs in roadside ditches and springs. On April 20, 1952 a large Bullfrog was found in a cold spring. During the summer months I have observed half-grown Bullfrogs in damp meadowlands. I have taken half-grown Bullfrogs under stones along the shores of lakes in mid-October and have also observed a few Bullfrogs around cold springs in early November. After September 20 or October 1, depending on weather conditions, Bullfrogs were never seen resting on lily pads in the lakes and ponds.

It is possible that *Rana septentrionalis*, the Mink Frog, occurs in the Browns Flat area but I have never collected or observed it there. This may have been due to insufficient collecting at favourable localities. Bleakney (1958) mentions this species as common in northern and south-central New Brunswick with records from the counties of Madawaska, Restigouche, York, Saint John and Albert. Logier and Toner (1961) mention an additional record for York County and there is a specimen (No. 5931) in the Royal Ontario Museum from Digdeguash River, Dumbarton Township, Charlotte County, which was collected by W. B. Scott and E. J. Crossman in May 1958. While on field work for the National Museum of Canada during late August 1959 I found the Mink Frog to be the most common species at Twin Lakes, about 12 miles north of St. Andrews and about 12 miles northeast of St. Stephen. Nineteen specimens were collected at that time and later deposited in the National Museum of Canada (NMC 4970, NMC 4979). No Mink Frogs were observed in other lakes in the same general area. However in a small lake near Piskehagen (in Sunbury County near the Charlotte County border) Mink Frogs were observed. Most of the Mink Frogs were observed resting on lily pads and appeared to hold the head and back lower than a Bullfrog would in a similar position. I have never observed or heard *Hyla versicolor*, the Gray Treefrog, in the Browns Flat area; however, it has been taken near Fredericton which is approximately sixty-five miles to the north. There are two specimens in the Royal Ontario Museum (Nos. 4605-4606) which were taken by C. E. Atwood on June 26, 1935 "½ mile from the mouth of the Nashwaak River".

Bleakney (1958) also reported this species from vicinity of Fredericton. *Hemidactylium scutatum*, the Four-toed Salamander, is found in Ontario, Quebec and Nova Scotia and with sufficient collecting in favourable localities it is likely that it will be taken in New Brunswick. The bogs bordering some of the lakes in the Browns Flat area may be suitable habitat for this species but although I have looked for it my efforts have been unsuccessful.

Comparative data (earliest spring appearance, or earliest calling date) with Logier (1952):

	Browns Flat area, New Brunswick	southern Ontario
Ambystoma maculatum	April 3	early April
Ambystoma laterale	April 9	early April
Notophthalmus viridescens	late April	middle or late April
Desmognathus fuscus	April 20	———
Eurycea bislineata	early May	———
Plethodon cinereus	middle May	———
Bufo americanus	late April	late April
Hyla crucifer	April 4	April
Rana sylvatica	April 9	late March or early April
Rana pipiens	April 30	April
Rana palustris	April 29	———
Rana clamitans	late April	———
Rana catesbeiana	April 20	———

Of the six species of salamanders and nine species of frogs and toads known from New Brunswick, thirteen are found in the Browns Flat area. Nova Scotia has five species of salamanders (one of which has not yet been found in New Brunswick) and eight species of frogs and toads. Prince Edward Island has four species of salamanders and five species of frogs and toads. (Bleakney, 1958; Logier and Toner, 1961; Cook, *In Press*).

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THE ROCK PTARMIGAN, *LAGOPUS MUTUS RUPESTRIS*, IN ONTARIO AND MANITOBA

HARRY G. LUMSDEN
Ontario Department of Lands and Forests, Maple, Ontario

FOR SOME YEARS Indians in Northern Ontario have reportd the occurrence of Rock Ptarmigan on the Ontario coast of Hudson Bay. The purpose of this paper is to place on record the recent information on the status of the bird in Ontario and Manitoba and to summarize the history of its discovery in the Hudson Bay area.

EARLY RECORDS

The earliest mention of the occurrence of Rock Ptarmigan on the south-western Hudson Bay coast is that of Isham who completed his *Observations on Hudson's Bay* in 1743 (Rich and Johnson, 1949). He describes wood partridges (Spruce Grouse *Canachites canadensis*), willow partridges (Willow Ptarmigan *Lagopus lagopus*) and rock partridges saying that the last are smallest and are white with black from the eye to the bill and with 14 black tail feathers.

Isham was stationed at York Factory and Churchill during his years of service with the Hudson's Bay Company in Canada, and probably became familiar with the bird during its winter invasions of that area.

There is another early mention of the occurrence of Rock Ptarmigan on the south shore of Hudson Bay in another manuscript titled *Observations on Hudson's Bay* (about 1782). This manuscript has been attributed to Dr. Thomas Hutchins, but Glover (*in* Rich and Johnson, 1951), has pointed out that it is in all probability by Andrew Graham. Glover wrote as follows about this manuscript ". . . . long attributed to Thomas Hutchins . . . . is in many places identically worded with other versions of Graham's "Observations" and contains internal evidence showing that Hutchins could not have written it. To Graham, then, is due the credit for the information on birds and animals for which naturalists using this manuscript have made acknowledgement to Hutchins."

The first of those who used this manuscript was probably Pennant who quoted part of Graham's section on the Rock Ptarmigan almost verbatim in the second edition of his Arctic Zoology (1792). (First edition 1784-87 not seen.) He then clearly had access to Graham's manuscript.

At the time that Pennant was preparing and publishing the first edition of his work, Dr. Thomas Hutchins was the corresponding secretary of the Hudson's Bay Company in London; it is very likely that Pennant met him because in the second edition of his Arctic Zoology he wrote that: "I was unspeakably obliged for his [Hutchins] judicious remarks made during 16 years residence in Hudson's Bay of which he most liberally indulged me with the perusal." This is clearly an acknowledgement of the loan of a manuscript. Could this have been the one by Graham? The warmth of his remarks suggest

a personal acquaintanceship. Pennant's acknowledgement of help from Andrew Graham is far less warm, it merely mentions "numbers of observations" and "the use of multitudes of specimens of animals transmitted by him to the late Museum of the Royal Society."

Graham (about 1782) had this to say about the Rock Ptarmigan. "Uscathachish. Is a bird of the Grous Genus and denominated by us the rock partridge. At all seasons of the year it frequents dry rocky ground and Juniper plains. Its natural history corresponds with the Ptermigan only it is a size smaller; has a black line under each eye and makes a croaking noise which is performed with a stretched neck and seeming difficulty. They are numerous on the extremes of the Bay and never visit our middle settlements but when the Ptermigans are scarce and too truly denotes a hard winter with the poor natives."

Manning (1952) has pointed out that Pennant's description of the Rock Ptarmigan (which was really Graham's) was the basis for Gmelin's (1789 not seen) formal description of *Tetrao rupestris*. The type locality was given as "in borealibus oris ad sinum Hudsonis = shores of Hudson Bay" (American Ornithologists Union Check List, 1957). Graham encountered the southern race of the Rock Ptarmigan, now known as *Logapus mutus rupestris* some time during his service on Hudson Bay. The only trading posts at which he served in Canada, prior to the completion of his *observations*, according to A. M. Johnson (Archivist, Hudson's Bay Company, *pers. com.*) were Fort Prince of Wales, at the mouth of the Churchill River and opposite the present site of Churchill, York Factory, and Fort Severn. Rock Ptarmigan are likely to occur at all three of these localities (see below) but are far more regular in occurrence and more abundant in the Churchill area. It is reasonable then to restrict the type locality of this form to "Fort Prince of Wales, Manitoba".

Swainson and Richardson (1831) in listing two species of Rock Ptarmigan did not recognize as we do today a single species with a circumpolar distribution. They quoted Graham with the credit again going to Hutchins under the heading *Tetrao rupestris* and added ". . . . is found on Melville peninsula and the barren grounds seldom going further south in winter than Latitude 63° in the interior but descending along the coast of Hudson's Bay to Latitude 58° and in severe seasons still further southward." Under the heading *Tetrao mutus* they list " . . . . a specimen in summer plumage sent to Sir John Franklin from Churchill river [which] was identified by John Sabine esq. with the Scotch Ptarmigan thus establishing it as an inhabitant of the American continent."

Hellmayr and Conover (1942) state that Audubon gave the range for his *Lagopus americanus* as "Melville Island, Churchill River", and further remark that Audubon later quoted Richardson as his authority for the Churchill River locality. Today we recognize that different races of Rock Ptarmigan occur at these two localities. Hellmayr and Conover (1942) therefore recognize the priority of Audubon's name for the northern race with the type locally "Melville Island". Gmelin's name *rupestris*, however, applies to the southern race which occurs at "Churchill River" with the type locality restricted here to "Fort Prince of Wales, Manitoba".

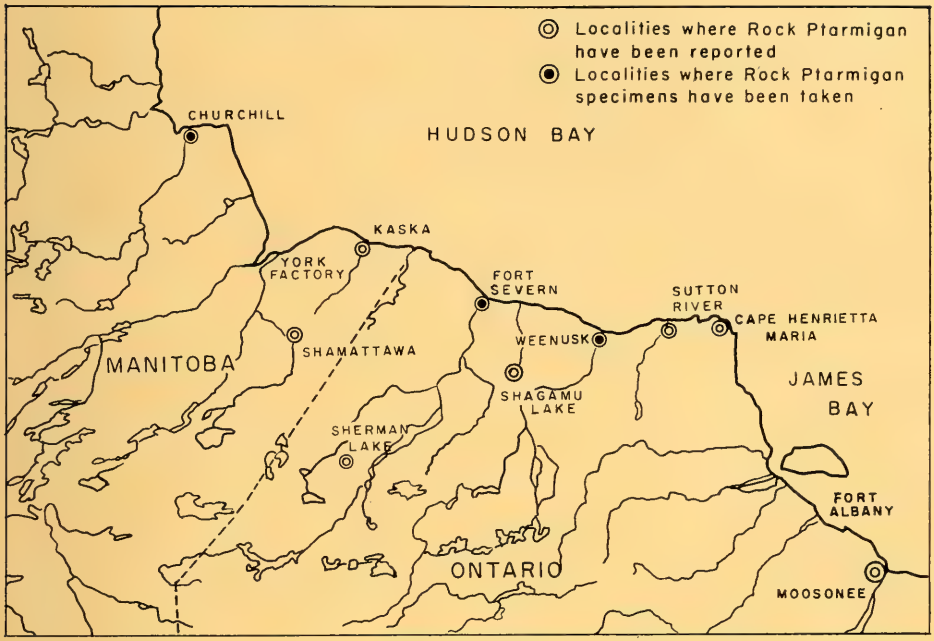

FIGURE 1. Localities in Ontario and Manitoba mentioned in the text.

In 1845 Dr. Gillespie Jr. of the Hudson's Bay Company presented a collection of birds to the Edinburgh Museum among which was a pair of Rock Ptarmigan in winter plumage (Clarke, 1890). They were collected by him during his residence at Fort Churchill.

Macoun (1900) wrote somewhat inconsistently that: "No authentic records of its being taken in Ontario or southern Quebec have been seen and the same statement may be made of Manitoba and westward." However, he later quotes Richardson's statement that they descend along the Hudson's Bay coast to Lat. 58° (which would include the Churchill area), and in severe seasons to Lat. 55°. This latitude was actually not mentioned by Swainson and Richardson (1831); it does, however, include the whole Hudson Bay coast of Ontario.

According to Preble (1902) the people of Fort Churchill say that the species occurs at that post regularly in winter.

RECENT RECORDS AND REPORTS FROM MANITOBA

Taverner and Sutton (1934) reported that: "Lloyd, who was stationed at Churchill for several years, saw Rock Ptarmigan every winter, but he was of the opinion that the species never occurs regularly in summer." They found Rock Ptarmigan rather numerous at Churchill in May and early June, 1931. They recorded their last observation of the species on July 10. In 1930 the only one they collected was an autumn plumaged bird taken on August 19 near

Fort Prince of Wales. They reported this to be a female but W. E. Godfrey, Curator of Birds, National Museum of Canada, in a personal communication states that the only specimen in the National Museum taken on that date at that locality was an adult male.

Figure 1 shows the localities round the Hudson Bay coast of Ontario and Manitoba mentioned in the text and the places from which Rock Ptarmigan have been reported.

There seems to be no specimen evidence at present of Rock Ptarmigan breeding anywhere in Manitoba, although the Manitoba Department of Mines and Natural Resources (1945) suggests that the species may breed in the Churchill area.

In the Registered Trapline annual reports for Manitoba there are three recent references to the occurrence of Rock Ptarmigan in that province. All refer to the winter season.

Mr. T. M. Nichol (1954) then with the Manitoba Game Branch in his 1953-54 report mentions that: ". . . . The Kaska trappers reported an increase in rock ptarmigan." Again in his 1954-55 report he states that: ". . . . A few rock ptarmigan were reported from the Kaska group." The Kaska Indians occupy the coastal area east of Cape Tatnum adjacent to the Ontario Boundary.

The third reference to the species was made by Mr. W. R. Burns (1957) Manitoba Game Branch in his 1956-57 report for the Churchill area. He states that both Willow and Rock Ptarmigan were found in the Churchill area but the latter were scarce.

Sometimes Rock Ptarmigan may penetrate inland south of the area occupied by the Kaska Indians. At Shamattawa, Mr. Stephen Redhead told me that he saw a flock of three during the winter of 1961-62 about five miles northwest of the village on the God's River.

Recent Records and Reports from the Hudson Bay Area of Ontario

The Indians living in the northern part of the Patricia portion of Ontario know the Rock Ptarmigan well and call the bird "Apistabemish". They say that flocks appear on their traplines in winter only, at intervals of six or eight years. Unless otherwise stated, the reports on the distribution of the Rock Ptarmigan in Ontario which follow were derived from personal communications.

Mr. Joseph Chokomolin told me that during the hard winter of 1935 his brother John killed six small ptarmigan, at the mouth of the Sutton River. He said that they all had black feathers between the eye and the bill.

During the winter of 1956-57, Conservation Officer T. M. Nichol, then with the Ontario Department of Lands and Forests, reported a single Rock Ptarmigan on the airport at Weenusk.

During he winter of 1960-61, a small flight of Rock Ptarmigan penetrated as far as the region of Shagamu Lake (55°05′N, 87°05′W). Mr. Michel Hunter, the chief of the Weenusk Indian band, shot about 15 Rock Ptarmigan there on his trapline. He also killed over 100 Willow Ptarmigan during the same winter. He saved one Rock Ptarmigan and took it to Weenusk as a specimen but it was later destroyed in error.

The winter of 1961-62 was marked by a major flight of both Willow and Rock ptarmigan into the Hudson Bay area of Ontario. Rock Ptarmigan were most abundant close to the coast but one Ontario report refers to birds in the interior. Mr. Joseph Morris, the chief of the Big Trout Lake Indian band, told me that he saw a flock of about 30 Rock Ptarmigan ten miles north of Sherman Lake at 54°38′N, 91°25′W; which is about 180 miles from the Hudson Bay coast.

At Fort Severn Willow Ptarmigan were extremely abundant and both Mr. Fred Close of the Hudson's Bay Company and Mr. Angus Miles reported that many thousands were killed for food by the villagers during the winter. Mr. Close told me that about one in fifty was a Rock Ptarmigan. He personally killed three Rock Ptarmigan in one day but kept no record of the total number he killed during the winter.

Mr. Mason Koostachin reported that there were about 20 Rock Ptarmigan among the Willow Ptarmigan he killed near Fort Severn during the winter of 1961-62.

At Weenusk also, Rock Ptarmigan were abundant and Mr. Michel Hunter said he saw flocks numbering from 25 to 60 birds. They fed in the willows along the coast and frequently flew out onto the sea ice where he saw them while trapping arctic foxes. He killed 30-35 Rock Ptarmigan and 60-70 Willow Ptarmigan during the winter while trapping west of the mouth of the Weenusk River. He reported that they arrived just before Christmas, 1961, and did not leave until the snow began to thaw at the end of March, 1962.

Mr. Moses Koostachin reported that Rock Ptarmigan were present on his trapline, which lies east of the mouth of the Weenusk River, during the winter of 1961-62. His son John George Koostachin killed two there that winter.

Mr. Xavier Sutherland told me that Rock Ptarmigan occur regularly in winter on Cape Henrietta Maria and birds were present in 1960-61 and 1961-62.

Seven specimens were preserved from the 1961-62 flight, one is in the Royal Ontario Museum of Zoology and Palaeontology and six are at the Southern Research Station, Maple. There were three males and one female killed in January, 1962 by Mr. Elijah Stoney and Mr. Peter Patrick at Fort Severn; and two males and one female killed on March 25, 1962 by Mr. Michel Hunter at Weenusk.

RECENT REPORTS FROM THE JAMES BAY AREA

Baillie (1956) has suggested, on the basis of a report from Mr. Sam Waller, who lived at Moosonee for some years, that Rock Ptarmigan might be found some winters in the James Bay region. According to Mr. Simeon Scott and other Indians, who were present at Fort Albany when I enquired, Rock Ptarmigan are never found north of Moosonee on the west side of James Bay. They all said that Cape Henrietta Maria was the nearest place where the species might be found.

In Qubec, on the east side of James Bay, however, the situation is quite different. Mr. Josie Sim at Fort George said that both species of ptarmigan

occur there. The Rock Ptarmigan appear only in winter, they come every year and occasionally in great numbers.

Farther south at Rupert House, Mr. Willie Weestchee and Mr. Isiah Salt told me that the Rock Ptarmigan, which they call "Skangish", appear nearly every winter.

Rupert House lies about 80 miles east and a little north of Moosonee on the southern end of James Bay. I seems likely then that if Rock Ptarmigan do occur at Moosonee, they come from the Quebec side of James Bay and not from the west.

Taverner and Sutton's (1934) summary of the status of the Rock Ptarmigan in the Churchill area of Manitoba as "a winter visitor irregularly common", can probably not be improved. In Ontario the species should be regarded as a periodic winter visitor in the extreme north occurring sometimes in substantial numbers, and of hypothetical occurrence at the southern end of James Bay.

ACKNOWLEDGMENTS

I should like to acknowledge the help of Miss A. M. Johnson, Archivist and Mrs. S. S. Smith, Librarian of the Hudson's Bay Company, who supplied me with biographical sketches of Thomas Hutchins and Andrew Graham and drew my attention to the correct authorship of the manuscript "Observations on Hudson's Bay". The quotation on Rock Ptarmigan from this manuscript is published by permission of the Governor and Committee of the Hudson's Bay Company. Dr. E. F. Bossenmaier sent unpublished references on the occurrence of Rock Ptarmigan in Manitoba and gave permission for publication. Finally, I am grateful to Mr. M. Hunter, Mr. E. Stoney and Mr. P. Patrick who collected specimens and preserved them for me.

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FISH COLLECTIONS FROM EASTERN HUDSON BAY

D. E. McALLISTER
National Museum of Canada, Ottawa, Ontario

INTRODUCTION

FEW COLLECTIONS have been made in the eastern waters of Canada's inland sea, Hudson Bay. Vladykov (1933) and Dymond (1933) describe the marine fish and summarize past literature. Dunbar and Hildebrand (1952) describe the fishes of Ungava Bay. The only further marine ichthyofaunal study has been that of Edwards (1961) on the fishes of Richmond Gulf. However, reports on single species have appeared: McPhail (1961) on Arctic charr and (1963) on ninespine stickleback, Legendre (1961) on the Greenland cod and Scott (1960) on the round whitefish. McAllister (1960) provided a key to the marine Arctic Canadian fishes, including Hudson Bay. References to the literature up to 1960 on freshwater fishes may be obtained from Harper (1961) and Fowler (1961). Power and Oliver (1961) give freshwater records from the southern Ungava Bay drainage.

The area must still be considered poorly known as each study has revealed further species. In Richmond Gulf, for example, the National Museum of Canada expedition in only ten marine stations was able to add four species to Edward's (1961) list—the lumpfish, round whitefish, lake whitefish, and the Arctic sculpin. One collection by the Fisheries Research Board in 1959 has been found to contain a further species, the American plaice, *Hippoglossoides platessoides*. Further work would be worthwhile, particularly in the deeper waters.

This paper briefly reports on marine and freshwater fishes collected by the National Museum of Canada expedition to eastern Hudson Bay in the summer of 1963. The author and Dr. A. H. Clarke, Jr., assisted by Mr. H. D. Athearn, collected fishes, molluscs, and other invertebrates from Port Harrison in the north to Moosonee, James Bay, in the south. Additional collections made by John G. Robertson at Povungnituk in 1963 are also reported on. Figure 1 shows the locality of the collecting sites; Table 1 presents the field data.

ITINERARY

The author left Ottawa on July 7, by train and arrived at Moosonee July 8. On July 10 he took off by Canso aircraft for Port Harrison and en route picked

TABLE 1.—Field Data for Collections

Coll. No.	Locality	Salinity	Temperature °C	Bottom	Capture Depth - Feet	Gear
NMC63-162	P.Q.: Povungnituk	—	16	stones, pebbles	—	seal net
NMC63-163	P.Q.: Povungnituk	—	—	algae and seaweed rocky	—	gill net
NMC63-164	P.Q.: Povungnituk	salt	—	algae and seaweed stones, pebbles	5–30	line with spoon gill net
NMC63-165	P.Q.: Povungnituk	salt	—	algae and seaweed stones, pebbles	5–30	line with spoon
NMC63-166	P.Q.: Small stream entering Povungnituk R.	fresh	—	algae, rocky	2	gill net
NMC63-167	P.Q.: Povungnituk	salt	—	algae and seaweed rocky	10–40	line with spoon
NMC63-168	P.Q.: Povungnituk	salt	—	algae and seaweed rocky	4–20	line with spoon
NMC63-169	P.Q.: Povungnituk	—	—	algae, rocky	2	3 inch gill net
NMC63-170	P.Q.: Povungnituk	—	—	algae, rocky	3–6	gill net
NMC63-171	P.Q.: Povungnituk	—	—	rocky	1–3	gill net
NMC63-172	P.Q.: Povungnituk	salt	—	algae and seaweed rocky	10–20	line with spoon
NMC63-173	P.Q.: Povungnituk	—	—	algae, rocky	½–3	gill net
NMC63-174	P.Q.: Povungnituk	—	—	rocky	—	—
NMC63-175	P.Q.: Povungnituk	—	—	—	—	gill net
NMC63-176	P.Q.: Small stream entering Povungnituk R.	fresh	—	algae, rocky	½–5	gill net
NMC63-177	P.Q.:PovungnitukR.	fresh	—	algae, rocky	½–5	gill net
NMC63-178	P.Q.:PovungnitukR.	fresh	—	algae, rocky	½–5	gill net
NMC63-179	P.Q.:PovungnitukR.	—	—	rocky	15–30	line with spoon
NMC63-180	P.Q.:PovungnitukR.	fresh	—	algae, rocky	½–5	gill net
NMC63-195	P.Q.: Head Five Mile Inlet	7.9 parts per thousand	8.5	algae, sand	0–3	bag seine
NMC63-196	P.Q.: Head Five Mile Inlet	7.9 parts per thousand	9.0	rocky	0–2	rotenone
NMC63-197	P.Q.: Rivermouth, head Five Mile Inlet	probably brackish	3	boulders	8–15	3-inch gill net
NMC63-198	N.W.T.: off n. end Patterson I.	salt	ca. 4	mud	60	2-foot dredge
NMC63-199	P.Q.: rill tributary to lake 3 mi. ne. Port Harrison	fresh	10.5	grass, pebbles, mud	0–2½	rotenone
NMC63-200	P.Q.: mainland opp. Hotchkiss Is.	28 parts per thousand	6	sand	0–3	bag seine
NMC63-201	P.Q.: mainland opp. Hotchkiss Is.	salt	6	boulders, gravel	20–40	¾-and 2½-inch gill net
NMC63-202	P.Q.: mainland opp. Hotchkiss Is.	salt	9.5	sand and clay few boulders	0–3	rotenone
NMC63-203	P.Q.: bay ⅓ mi. off mouth Kikkerteluk R.	salt	—	—	60	¾- and 2½-inch gill net
NMC63-204	P.Q.: mouth Kikkerteluk R.	—	—	rock and sand	0–3	3-inch gill net
NMC63-205	P.Q.: 2 mi. above mouth Kikkerteluk R.	fresh	—	weeds	—	dipnet
NMC63-206	N.W.T.: Tottenham Bay[1] ne. end Broughton I.	24partsper thousand at surface	8.5	sand	25	¾- and 2½-inch gill net
NMC63-207	N.S.T.: Tottenham ne. end Broughton I.	24 parts per thousand	8.5	fucus, boulders	0–2	rotenone
NMC63-208	N.W.T.: lakes, centre Broughton I.	fresh	14	gravel, sand, boulders	1–3	line with spinner
NMC63-209	N.W.T.: side pool, upper lake, centre Broughton I.	fresh	+14	grass, sand, silt	0–½	rotenone
NMC63-210-S	N.W.T.: found on shore e. central Broughton I.	—	—	—	—	—
NMC63-211	N.W.T.: bay, s. end Mowat I.	salt	10	—	40	¾- and 2½-inch gill net
NMC63-212	N.W.T.: bay, s. end Mowat I.	salt	10 at surface	fucus, rocky	10	jigging with spoon
NMC63-213	P.Q.: Nastapoka R. 2 mi. above mouth	fresh	—	sand, gravel	1/12	dipnet

[1]Suggested name for unnamed bay at 57°25′N, 76°49′W, at northeast end of Broughton Island (see fig. 1 and 4). Named after Const. R. L. Tottenham of the Northwest Mounted Police.

Table 1.—cont'd.

Coll. No.	Locality	Salinity	Temperature °C	Bottom	Capture Depth - Feet	Gear
NMC63-214	N.W.T.: bay, ne. end Anderson I.	salt	—	sea urchins, brittle stars	30–35	gill net
NMC63-215	N.W.T.: stream, enters bay ne. end Anderson I.	fresh	6	algae clumps sand, silt, detritus	$\frac{1}{12}$–$\frac{4}{12}$	dipnet
NMC63-216	N.W.T.: lake, 35-ft. altitude ne. end Anderson I.	fresh	—	boulders and sand	1–2	hand
NMC63-217	N.W.T.: tide pool s. tip Ross I.	salt	10	rocky with boulders and gravel	0–1	rotenone
NMC63-218	P.Q.: pool, lake outlet s. side large island, Richmond Gulf	fresh	—	weeds, sand	$\frac{2}{12}$	hand
NMC63-219	P.Q.: bay s. side large island, Richmond Gulf	ca. 14–16 parts per thousand	14	sand	1–3	bag, seine
NMC63-220	P.Q.: bay s. side large island, Richmond Gulf	+16 parts per thousand	10 at surface	sand, silt	5–20	¾- and 2½-inch gill net
NMC63-221	P.Q.: bay s. side large island, Richmond Gulf	fresh	16.5	algae, boulders	0–3½	rotenone
NMC63-222	P.Q.: Deer R. 2 mi. above mouth, Richmond Gulf	fresh	16.5	algae, boulders	4	gill net
NMC63-223	P.Q.: Richmond Gulf 2 mi. w. Deer R. mouth	salt	—	mud and clay	36–90	2-foot dredge
NMC63-224	P.Q.: Richmond Gulf 3 mi. nw. Deer R. mouth	salt	—	—	—	floating 4-inch gill net
NMC63-225	P.Q.: island off Charr Lake[2] w. central Richmond Gulf	ca. 16 parts per thousand	18	fucus, boulders and sand, rocky	0–3	rotenone
NMC63-226	P.Q.: Charr L.[2], w. central Richmond Gulf	fresh	—	—	—	—
NMC63-227	P.Q.: just outside Clearwater R. lagoon	somewhat brackish	—	sand	0–2	bag seine
NMC63-228	P.Q.: Clearwater R. just below rapids at mouth	fresh	—	boulders	0–10	2-inch gill net
NMC63-229	P.Q.: lagoon, mouth of Clearwater R.	brackish	—	—	12	¾- and 2½-inch gill net
NMC63-230	P.Q.: bog pond, shore Clearwater R. lagoon	fresh	—	grass, moss, black mud	1½	dipnet
NMC63-231	P.Q.: bay, s. of e. end of Gulf Hazard, in Richmond Gulf	salt	12.5 at surface	boulders and sand	10–15	jigging with spoon
NMC63-232	P.Q.: bay, s. side of e. end of Gulf Hazard	salt	—	algae mat on gravel	0–2½	bag seine
NMC63-233	P.Q.: bay, s. of e. end of Gulf Hazard, in Richmond Gulf	salt	—	sea urchins and shells	25	¾- and 2½-inch gill net
NMC63-234	P.Q.: bay, s. of e. end of Gulf Hazard, in Richmond Gulf	salt	—	boulders, sand	7–15	2-inch gill net
NMC63-235	N.W.T.: n. end of Castle I. in e. end of Boat Passage	salt	—	fucus, sea urchins mussels, rocky	15–50	¾- and 2½-inch gill net
NMC63-236	P.Q.: bay n. central shore Burton L.	fresh	ca. 18	sand and detritus patches	0–2½	bag seine
NMC63-237	P.Q.: creek, n. central shore Burton L.	fresh	—	mud, gravel patches	0–3	bag seine
NMC63-238	P.Q.: middle branch Roggan R.	fresh	—	rocky	—	angling
NMC63-239	Ont.: Moose R. at Moosonee	fresh	24	mud	0–3	bag seine
NMC63-240	Ont.: creek tributary to Moosonee 3 mi. above mouth at Moosonee	fresh	20.5	mud	0–6	dipnet

[2]Unofficial local name for lake, unnamed on charts.

up Dr. Clarke and Mr. Athearn at Great Whale River. We collected in the Port Harrison area until July 13, when we left via chartered trap boat (see Figure 7) for Great Whale River. Collections were made on route to Great Whale River at numerous points. On July 23 the expedition arrived in Great Whale River; the boat and crew then returned to Port Harrison. A chartered flight was made to Burton Lake and Roggan River on July 24. The following day we left via Canso for Moosonee. Final fish collections were made on July 25 and 26 in the Moosonee area. The author then returned to Ottawa by train.

CONDITIONS

Ice was reported to have broken up on the Moose River at Moosonee on May 18 and on James Bay on June 18. On the trip up, little ice was seen on James Bay. In Hudson Bay there were rare patches of ice south of Great Whale River, a few broader patches northward; rivers and lakes were completely ice free, but a few ravines had snow. On the return trip by boat only a single piece of ice was seen. Weather during the boat trip varied from cool to warm, never approaching freezing. About half the days were cloudy, and most cloudy days had some rain. Winds were light, the maximum being about 40 mph. In Richmond Gulf swimming was comfortably indulged in. Water temperatures at collecting stations varied from 3° to 18° C in brackish and salt waters (the highest temperatures of 14 and 18° C in Richmond Gulf, 10° C elsewhere) and from 10.5 to ca. 18° C in freshwater (except in Moosonee area where 20.5° and 24° were recorded). In Gulf Hazard, which joins Hudson Bay to Richmond Gulf, surface temperatures were cooled to 3.5 ° C at its narrowest and most turbulent point; here mist formed above the water.

Twenty-eight species of fishes (12 marine, 5 anadromous, and 11 freshwater), belonging to 14 families were collected. These are discussed below in phylogenetic order. The collection number and the number of specimens (in parentheses) are given for each collection of that species.

SPECIES

RAJIDAE

Raja radiata Donovan, THORNY SKATE, raie de mer épineuse.

Collections: NMC62-233 (1)

Represented only by an egg capsule. Although the capsule is of smaller size (36x48 mm) than those given by Vladykov (1936), 48-73x66-90 mm, they are within the limits of those given by Jensen (1948), 24-41x45-66. *Raja radiata* is the only skate known from Richmond Gulf (Edwards 1961), or indeed Hudson Bay.

SALMONIDAE

Salmoninea

Salvelinus namaycush (Walbaum), LAKE CHARR (TROUT), touladi. Figure 2.

Collections: NMC63-208 (2).

One specimen had eaten half a dozen *Pungitius pungitius.*

Salvelinus alpinus (Linnaeus), ARCTIC CHARR, omble chevalier.

Collections: NMC63-162 (1); NMC63-163 (2); NMC63-170 (1); NMC63-173 (2); NMC63-178 (1); NMC 63-180 (1); NMC 63-197 (not kept); NMC 63-199 (3); NMC 63-204 (2); NMC63-226 (2).

This species is being commercially fished by Eskimos in Richmond Gulf with Department of Northern Affairs co-operation.

Salvelinus fontinalis (Mitchell), BROOK CHARR (TROUT), omble de la fontaine.

Collections: NMC63-169 (1); NMC63-176 (2); NMC63-177 (1); NMC63-178 (1); NMC63-205 (1); NMC63-208 (2); NMC 63-220 (2); NMC63-221 (26); NMC63-228 (22).

Specimens from the lower lake Broughton Island (NMC63-208) were apparently sea-

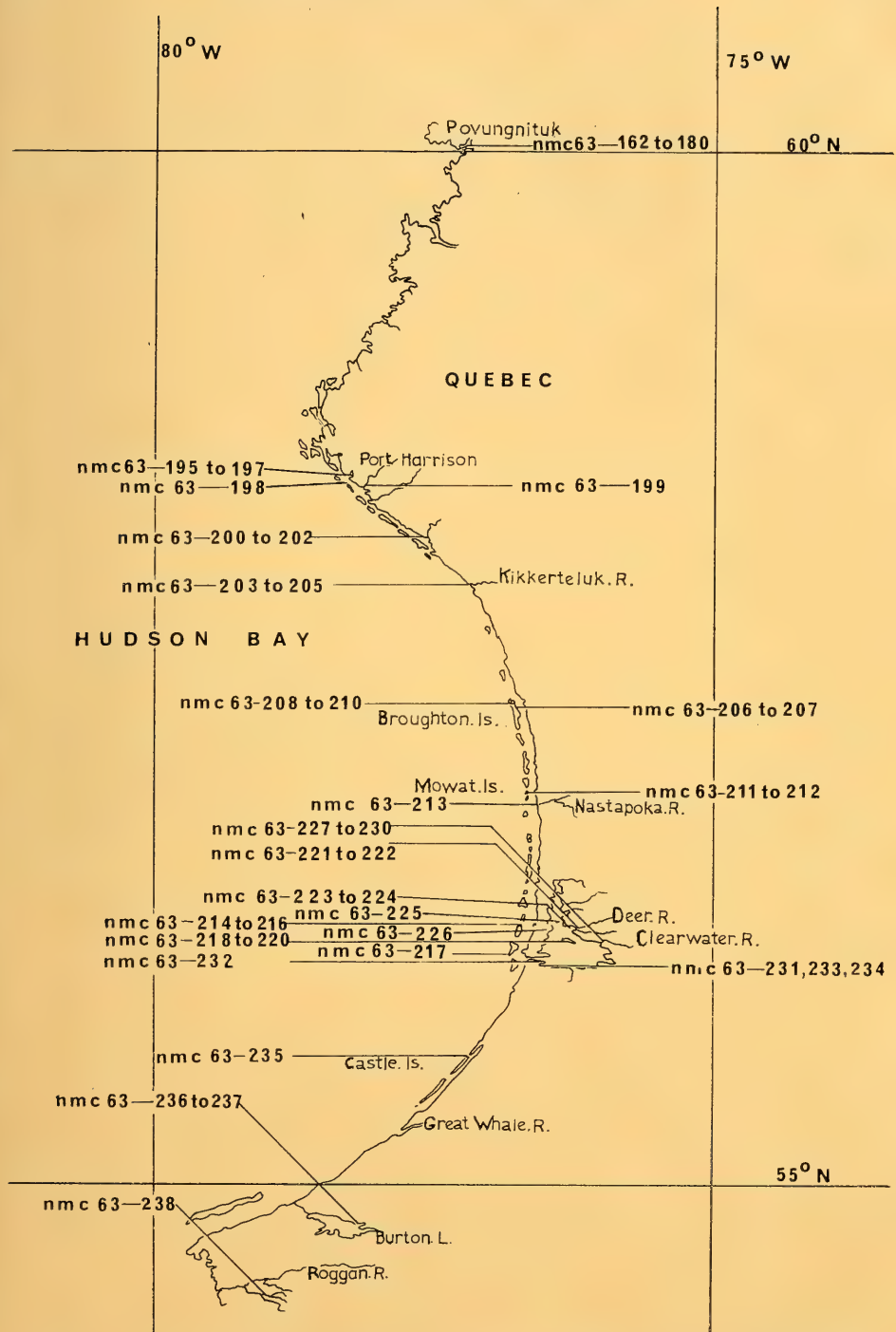

Figure 1. Map of eastern Hudson Bay showing collection sites of 1963 National Museum of Canada expedition. The Moosonee sites in southern James Bay are not shown. Numbers preceded by NMC are catalogue numbers.

run, as evidenced by copepods in their mouths. The Povungnituk specimens apparently extend the known range northward over 50 miles from the previous northernmost point of Payne Lake, mouth of outlet, reported by Legendre and Rousseau (1949). Brook charr specimens from 15 miles inland were also seen at Port Harrison (but not preserved).

Coregoninea

Prosopium cylindraceum (Pallas), ROUND WHITEFISH, ménomini.
Collections: NMC63-178 (1); NMC63-180 (1); NMC63-228 (3); NMC63-229 (1).

All collections were from fresh water, except NMC63-229 which was brackish. The northernmost Quebec record in the literature appears to be Bateman's (*in* Harper, 1961) at Iron Lake south of Leaf Bay. The Povungnituk specimens are from over 75 miles north of this point. The species is known north of Povungnituk in the western Arctic, however.

Coregonus artedi Lesueur, CISCO, cisco. Figure 3.
Collections: NMC63-171 (1); NMC63-220 (11); NMC63-225 (1); NMC63-229 (2).

This species has apparently been known north only to Fort Chimo, in Quebec. The Povungnituk specimens are from over 130 miles north of that point. The species is known to range further north than Povungnituk in central Arctic Canada.

Coregonus clupeaformis (Mitchell), LAKE WHITEFISH, corégone de lac. Figure 8.
Collections: NMC63-171 (1); NMC63-176 (3); NMC63-177 (9); NMC63-178 (4); NMC63-180 (5); NMC63-204 (6); NMC 63-220 (1); NMC63-229 (1); NMC 63-236 (104); NMC63-239 (1).

The northernmost Quebec record appears to be the lower Leaf River. The Povungnituk specimens recorded here extend the known Quebec range over 75 miles further north. The species does occur further north than Povungnituk in the western Arctic. This species is being commercially caught in Richmond Gulf by Eskimos with Department of Northern Affairs' cooperation.

OSMERIDAE

Mallotus villosus (Müller), CAPELIN, capelan.
Collections: NMC63-220 (60).

About a thousand capelin were caught in one overnight set of a 30x6 feet panel of ¾-inch mesh; 60 were kept.

ESOCIDAE

Esox lucius Linnaeus, NORTHERN PIKE, grand brochet.
Collections: NMC63-238 (2).

Pike were reported in Clearwater Lake, inland from Richmond Gulf.

CATOSTOMIDAE

Catostomus catostomus (Forster), LONGNOSE SUCKER, meunier.
Collections: NMC63-166 (1); NMC63-176 (4); NMC63-178 (4); NMC63-180 (1); NMC63-221 (29); NMC63-222 (2); NMC 63-237 (1).

The most northerly record previously reported appears to be that of Dunbar and Hildebrand (1952) for the Leaf River. The Povungnituk specimens reported here are at least 75 miles north of this point.

CYPRINIDAE

Rhinichthys cataractae (Valenciennes), LONGNOSE DACE, goujon à long nez.
Collections: NMC63-213 (27); NMC63-221 (13).

The upper lip and lower fins of the Deer River specimens were red. The Nastopoka River specimens, though not constituting a northern record (they extend north in the interior to Whale River (Power and Oliver, 1961), are further north on the Hudson Bay coast than previous records.

Couesius plumbeus (Agassiz), LAKE CHUB, méné de lac.
Collections: NMC63-239 (1).

Notropis sp.
Collections: NMC63-239 (1).

GADIDAE

Gadus ogac Richardson, GREENLAND COD, ogac. Figure 6.
Collections: NMC63-162 (1); NMC 63-164 (8); NMC63-165 (16); NMC 63-167 (22); NMC63-168 (6); NMC63-172 (4); NMC63-179 (4); NMC63-197 (8); NMC 63-201 (26); NMC 63-206 (4); NMC 63-120-S (skeleton on beach); NMC63-212 (1); NMC63-214 (2); NMC 63-233 (3); NMC 63-245 (13).

This was one of the most commonly caught marine species. Its numbers might well provide the basis for local fisheries.

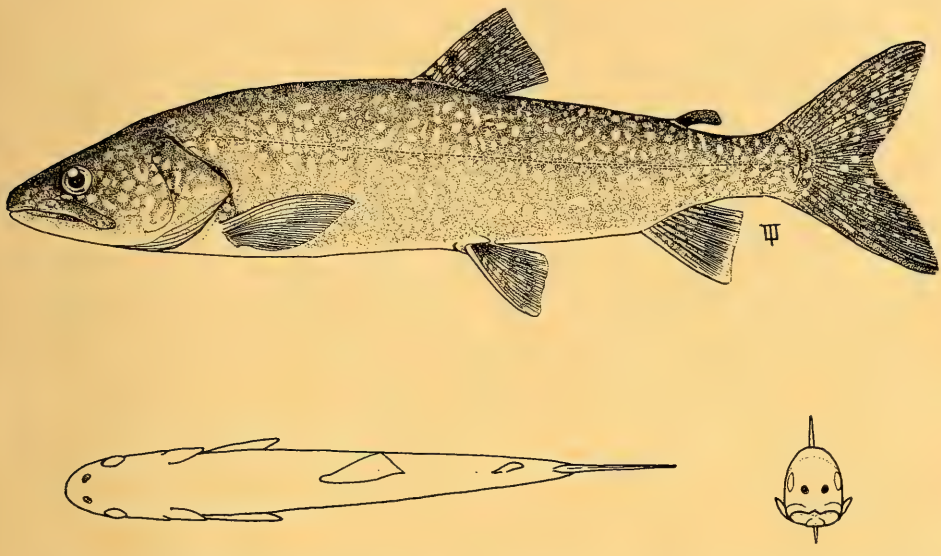

Figure 2. A lake charr, *Salvelinus namaycush*, 360 mm in standard length, from NMC 63-208, a lake on Broughton Island.

Figure 3. A cisco, *Coregonus artedii*, 262 mm in standard length, from NMC63-171, a stream at Povungnituk.

FIGURE 4. Tottenham Bay, Broughton Island, site of collections NMC63-206—gill net in 25 feet of water, sand, out from lefthand man—*Gadus ogac*, *Myoxocephalus scorpius*, *Lumpenus fabricii* and NMC63-207 rotenone among boulders with *Fucus*, near right-hand man—*Myoxocephalus scorpioides*, *M. scorpius*, *Stichaeus punctatus*.

PERCIDAE

Stizostedion vitreum vitreum (Mitchell), WALLEYE, doré jaune.
Collections: NMC63-237 (1).

COTTIDAE

Myoxocephalus quadricornis (Linnaeus), FOURHORN SCULPIN, chaboisseau à quatre cornes.
Collections: NMC63-164 (1); NMC 63-174 (1); NMC63-175 (1); NMC 63-195 (11); NMC63-196 (5); NMC63-200 (2); NMC63-201 (1); NMC63-202 (6); NMC63-220 (10); NMC63-229 (4); NMC63-232 (1); NMC 63-234 (3).

This was the most common species of *Myoxocephalus* caught, *scorpioides* the rarest. The three species of *Myxocephalus* rarely may be caught in the same gill net set (NMC63-234). *M. quadricornis* is generally caught in more brackish water (7.9–28°/oo) and in shallower depths (0–40 feet), *scorpius* in more saline water (16+ to 24+°/oo) and in deeper depths usually 5 to 50 feet deep.

Myoxocephalus scorpius (Linnaeus), SHORTHORN SCULPIN, chabolsseau espines.
Collections: NMC63-201 (2); NMC63-203 (1); NMC63-206 (12); NMC63-207 (19); NMC63-211 (2); NMC63-214 (5); NMC 63-220 (1); NMC63-231 (4); NMC63-234 (1); NMC63-235 (8).

Myoxocephalus scorpioides (Fabricius), ARCTIC SCULPIN, chaboisseau artique.
Collections: NMC63-207 (2); NMC63-217 (13); NMC63-234 (1).

The three collections of *M. scorpioides* were caught in generally saline water 0–15 feet deep.

Gymnocanthus tricuspis (Reinhardt), ARCTIC STAGHORN SCULPIN, tricorne arctique.
Collections: NMC63-211 (2); NMC63-233 (1).

In a male specimen, NMC63-211, there are bright white spots on the abdomen, on

Figure 5. Crew of cruise, left to right, Joe, Lasarus, Charlie and below, Judd.

the inside of pectoral fins and on both sides of the pelvic fins; these spots turn yellowish on the posterior of the body. The vertical fins are striped black and yellowish; the chin is yellowish; the head and most of the body are dark brown; the pineal region is white; the eyes are bronze coloured; the buccal cavity is white.

Cottus bairdii Girard, mottled sculpin, chabot.
Collections: NMC63-221 (2); NMC63-237 (3); NMC63-240 (1).

The Deer River collection extends the known coastal distribution considerably to the north, although it is known to extend almost to Ungava Bay in central Quebec.

Cottus cognatus Richardson, slimy sculpin, chabot visqueux.
Collections: NMC63-221 (35); NMC63-240 (4).

Agonidae

Aspidophoroides olrikii Lütkin, Arctic alligatorfish, poisson alligator arctique.
Collections: NMC63-198 (1).

Cyclopteridae

Cyclopterus lumpus Linnaeus, lumpfish, grosse poule l'eau.
Collections: NMC63-224 (1).

This specimen represents the first specimen for eastern Hudson Bay. Lumpfish were caught fairly commonly in floating gill nets set for Arctic charr in Richmond Gulf by

FIGURE 6. *Gadus ogac*, collection NMC63-201, from east side of Hopewell Channel, opposite Hotchkiss Island. Note the absence of a prominent white lateral band which is found in the related species, *Gadus morhua*.

FIGURE 7. The motor launch used on the cruise.

the Eskimo commercial fishing camp being started by the Department of Northern Affairs.

Stichaeidae

Stichaeus punctatus (Fabricius), Arctic shanny, stichée arctique.

Collections: NMC63-207 (3).

These specimens were brown bodied and had a reddish eye, the edge of dorsal and anal white, the pectoral and caudal with red-brown stripes, the anal with yellow and charcoal stripes, the dorsal yellow brown with black spots having yellow ocelli, and the chin with black stripes. They represent the first record for eastern Hudson Bay.

Lumpenus fabricii (Valenciennes), slender eelblenny.

Collections: NMC63-206 (1).

Ammodytidae

Ammodytes hexapterus Pallas, sand lance, lançon d'Amérique.

Collections: NMC63-195 (15); NMC63-219 (16); NMC63-227 (54).

Gasterosteidae

Pungitius pungitius (Linnaeus), ninespine stickleback, épinoche à neuf épines.

Collections: NMC63-195 (1); NMC63-199 (6); NMC63-208 (6 in stomach of lake charr); NMC63-209 (50); NMC63-215 (15); NMC63-219 (23); NMC63-226 (1); NMC 63-227 (12); NMC63-232 (9); NMC 63-236 (4); NMC63-247 (11).

Gasterosteus aculeatus Linneaus. threespine stickleback, épinoche à trois épines.

Collections: NMC63-215 (8); NMC63-216 (4); NMC63-218 (15); NMC63-219 (185); NMC63-221 (2); NMC63-226 (18); NMC 63-227 (73); NMC63-230 (21); NMC 63-232 (32); NMC63-237 (9).

The collections consist mainly of the *semiarmata* type, with a few of the *trachura* type.

Figure 8. *Coregonus clupeaformis*, collection NMC63-204, from mouth of Kikkerteluk River.

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The cooperation and assistance of Dr. A. H. Clarke and Mr. H. D. Athearn, who accompanied the author on the expedition and of the able Eskimo crew Lasarus, Charlie, Judd, and Joe who selflessly worked long hours, greatly contributed to the success of the expedition. To the director of the Protection Service, Jean Duguay, Département des Pêcheries et de la Chasse, is due thanks for authorization to collect fish specimens. Howard Dove, Hudson's Bay Company, and Rodney Evans, Department of Northern Affairs, of Povungnituk, assisted greatly in organization of the expedition. Dave Price contributed a specimen of lumpfish from Richmond Gulf, and David Neave two pike from Roggan River (both of the Department of Northern Affairs). The

elegant drawings and map are by John Tottenham. To all these persons the author is very grateful.

SUMMARY

Distribution and ecological data are presented from the 1963 National Museum of Canada expedition to eastern Hudson Bay. Twenty-eight marine and freshwater fishes are reported. The known northern limits in Quebec of *Salvelinus fontinalis*, *Prosopium cylindraceum*, *Coregonus artedi*, *Coregonus clupeaformis*, and *Catostomus catostomus* are extended. *Cyclopterus lumpus* and *Stichaeus punctatus* are reported for the first time from eastern Hudson Bay.

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THE FOOD HABITS OF THE RED-WINGED BLACKBIRD, *AGELAIUS PHOENICEUS*, IN MANITOBA*

RALPH D. BIRD and LAWRIE B. SMITH
Canada Department of Agriculture, Research Station, Winnipeg, Manitoba

THE RED-WINGED BLACBIRD, *Agelaius phoeniceus* (L.), has been shown to feed on a variety of vegetable and animal material. Beal (1900), examined the stomachs (gizzards) of 1083 Redwings collected throughout the United States at various times of the year and found vegetable matter to be 73.4 per cent of the yearly average with a large proportion being weed seeds. In farmed areas the food of autumn concentrations of Red-wings has been found to be mostly grain; rice in Arkansas (Neff and Meanley, 1957); corn in Ohio (Giltz and Stockdale, 1960) and South Dakota (DeGrazio, 1961); and sunflowers, wheat, oats, and barley in Saskatchewan (Hurd, 1962).

Allen (1914) studied the ecology of Red-winged Blackbirds in a cat-tail marsh in New York and examined the stomachs of about 100 birds. He found the food to be nearly 100 per cent vegetable in the spring and autumn, and 100 per cent insects in the mating and nesting periods.

This paper reports on food consumed by the Red-winged Blackbird and the habitat occupied by the species during its period of residence in agricultural and marsh areas, in south-central Manitoba, in 1960.

MATERIALS AND METHODS

Southern Manitoba, now intensively cultivated, is situated in the aspen parkland region of Western Canada (Bird, 1961). Red-winged Blackbirds nest in emergent vegetation around bodies of water in the farming area and in large marshes at a distance from cultivated land. Their use of nesting habitat in two different types of areas gave an opportunity to compare their food habits under disturbed conditions and under relatively natural conditions. Two representative agricultural areas and a marsh were selected for study.

Area I. Sunflower and cereal crop area near Altona, Manitoba

Cereal crops, sunflowers, sugar beets, field peas, corn and alfalfa were grown in this area, which is situated 80 miles southwest of Winnipeg near the North Dakota boundary. A small breeding population of Red-winged Blackbirds occurred along Buffalo Creek. They nested in cattails, *Typha latifolia* L., and bullrushes, *Scirpus* spp. In August and September thousands of migrants formed night roosts in the rushes and ranged into the adjacent fields to feed.

Area II. Cereal crop area northeast of Portage la Prairie, Manitoba

In this district, known locally as Flee Island, barley, wheat, and oats were the main crops. No sunflowers or corn were grown and there was only a small

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acreage of sugar beets and field peas. There was a small breeding population of Red-winged Blackbirds in ponds and roadside ditches. Large flocks of migrant Red-winged and Yellow-headed Blackbirds, *Xanthocephalus xanthocephalus* (Bonaparte), visited the fields to feed from roosts in the adjacent marshes at the south end of Lake Manitoba from July 20 to October 15.

Area III. Marsh area along the shore of Lake Manitoba near St. Ambroise, Manitoba

Large numbers of Red-winged and Yellow-headed Blackbirds nested in dense stands of reed grass, *Phragmites communis* Trin. var. *berlandieri* (Fourn.) Fern., rushes and cattails. They fed in adjacent hay meadows and left the area by August 20, as soon as the young were able to fiy. No grain fields were found within 10 miles.

The three study areas were visited every second week from May through October in 1960. While the birds were nesting, typical study sites within these areas were used for observations and collections. Later, flocks feeding in fields and pastures, and returning to roosts within the areas were studied. The birds were observed with a pair of 8 x 30 binoculars and a 15x telescope, and collections were made for gizzard analysis of at least four adults of each sex, and of nestlings when present, from each study site, or from flocks. In 1960, 434 Red-winged Blackbirds were collected.

Gizzard and gullets were removed, shortly after the balckbirds were shot, and preserved in 70% alcohol. The contents were examined in a petri dish under a binocular microscope. A combined method of volumetric and numerical analysis as recommended by McAtee (1912) and Hartley (1948) was used. The volume of food, in alcohol, was measured in cubic centimeters and the percentage of each item estimated by measurement over a quarter inch grid. Individual seeds and insects were identified and counted when possible.

RESULTS

Observations on the Ecology of the Red-winged Blackbird

Adult male Red-winged Blackbirds commenced to return in early April but it was not until May 1 that they were abundant and had started to defend territories. Females and immature males arrived about two weeks later than the males. Nesting commenced shortly thereafter and the first eggs were found on June 7. Nests were built in cattails, reed grass, sedges and willows growing in shallow water. Some nests were found in patches of snowberry, *Symphoricarpos occidentalis* Hack., in pastures adjacent to creeks or ponds without suitable nesting sites but there was no nesting in fields of grain or alfalfa as reported by Giltz and Stockdale (1960) for Ohio and Neff and Meanley (1957) for Arkansas. Roadside ditches with water and sufficient vegetation to support nests were utilized. A breeding population of 509 males and females was counted in roadside ditches on a single trip on May 24 along thirty miles of highway between Winnipeg and Poplar Point. Our observations indicated that Red-winged Blackbirds nested readily close to cultivated fields where grain gleanings and weed seeds were abundant since few breeding birds were found in a community pasture between Areas II and III that appeared to

contain suitable nesting habitat. However, larger marshes such as Area III were used, but the birds left that area when the young were able to fly, presumably to join flocks feeding in fields. The first fledgling was seen at the end of June and the last in the first week of August. There was no indication that there was more than one brood of young per breeding pair per season.

Flocks began to form as soon as the young were strong fliers. These flocks ranged in size from four or five hundred to a thousand or more and were seen feeding in fields during August and September. Most of the birds were migrants, some leaving for the south as others moved in from the north. The population was reduced by October and by the middle of the month only stragglers were left.

The flocks were predominantly Red-winged Blackbirds but other species, Yellow-headed Blackbirds; Brewer's Blackbirds, *Euphagus cyanocephalus* (Wagler); Common Grackles; Brown-headed Cowbirds, *Molothrus ater* (Boddaert); and Starlings, *Sturnus vulgaris* L., were associated with them. Mature males usually formed in flocks separate from those composed of females and immature males.

During the flocking period the blackbirds spent the night in roosts. The roost was usually in cattails, rushes or *Phragmites* growing in shallow water and contained many thousands of birds. Suitable sites for night roosts were an essential habitat requirement. Three were located in Area I and several were known to occur in the marshes adjacent to Area II. The birds returned to the roost during the hour before sunset and left the roost during the half hour after sunrise. During the day they alternately fed in fields, drank at nearby water (often a farm pond) and rested in adjacent trees between periods of feeding. Water and trees close to food and suitable sites for night roosts were essential requirements for blackbirds after the young were on the wing.

Analysis of the Food of the Red-winged Blackbird

The total volume of food and mineral grit found in the gullet and gizzard increased with the season. The average, per bird, for May, June, July, August and September was 1.25, 1.30, 1.60, 1.75 and 2.95 cc, respectively. Only after the young were flying and flocks had begun to form was food retained in the gullet, the quantity sometimes exceeding that in the gizzard. The mineral grit was greatest when the vegetable food was greatest and was absent when the diet was solely insects.

The food of the blackbirds in the agricultural districts, Areas I and II was similar. When the birds returned in the spring the food averaged 90 per cent vegetable material. Animal food, chiefly insects, increased to 70 per cent in June and early July, when the young were being fed. Vegetable food again became dominant when flocks commenced to form and was 69 to 94 per cent of the total contents when the birds left on migration (Tables 1 and 2). Although the adults continued to eat some vegetable food in June the nestlings were fed entirely on insects.

The food of the blackbirds nesting in the large marsh, Area III, was almost exclusively animal (Table 3). Some vegetable material was found in the

TABLE 1. — Gullet and gizzard contents of the Red-winged Blackbird from the sunflower and cereal area at Altona, Man., in 1960
(Percentages of total volume of food)

Date	May			June		July		Aug.		Sept.		Oct.		Total
	4	19	31	13	28	12	26	9	23	6	19	4	19	
Number of Blackbirds	2	13	12	20	27	25	27	19	12	9	5	7	5	183
Total Volume of Food cc	—	16.6	16.0	21.8	34.0	35.4	42.6	31.9	17.7	9.4	11.1	22.9	11.0	270.4
														Average
Vegetable Food														
Sunflowers	85	15.5	14.5	5	—	—	—	6.5	20	21	6	67	63	23
Wheat	—	2	19.5	11	11	9	2	14	—	10	4	—	—	6
Oats	—	—	8	8	4	—	5	13	18	16	1	—	—	6
Barley	—	—	—	—	2	—	5	0.5	T*	—	—	—	—	0.5
Corn	—	20.5	—	—	—	6	—	—	—	—	—	—	—	2
Wild oats	—	—	—	—	—	10	—	—	—	5	—	3	1	1.5
Green foxtail (*Setaria viridis*)	—	2	11	4	2	8	8	24	24	17	69	3	3	13.5
Wild buckwheat (*Polygonum convolvulus*)	—	2.5	—	—	—	—	4	T	6	—	T	4	1	1.5
Sedge & Smartweed	—	—	—	0.5	—	T	2	7	0.5	1	—	T	T	1
Incidental and Undetermined	—	15	2	0.5	1	3	1	T	T	—	—	1	—	2
	85	58	55	29	20	36	27	65	69	70	80	78	69	57
Animal Food														
Snails	—	T	T	T	1	T	T	T	T	T	—	T	—	
Phalangida	—	—	T	—	1	T	1.5	4	0.5	2	—	—	—	1
Spiders	—	0.5	—	1	1.5	T	1.5	1	—	T	—	—	—	1
Insects														
Odonata (Damselflies)	—	1	—	7	4.5	0.5	—	—	—	—	—	—	—	1
Grasshoppers	—	T	0.5	1.5	8	29	20	14	8	13	18	—	—	8.5
Crickets	—	—	—	—	—	—	T	3	22	10	—	7	—	3
Lepidoptera	—	0.5	12	12	8	1.5	12	0.5	—	—	—	—	—	3.5
Beet webworm	—	—	—	—	—	—	26	2	—	—	—	—	—	2
Coleoptera	—	14	10.5	18	23	21	6	2	1	—	—	—	—	7
Carabidae	5	0.5	19	12	1.5	—	—	—	—	—	—	3	—	3
Sweetclover weevil	—	—	—	9	2	T	1.5	3	—	—	—	—	—	1
Diptera	—	0.5	—	3	13	1	3	—	—	—	T	—	—	2
Incidental and Undetermined	—	14	—	1.5	14.5	5	0.5	0.5	—	1	—	T	T	3
	5	31	42	65	78	58	72	30	32	26	19	10	T	35
Mineral Grit														
	10	11	3	6	2	6	1	5	8	4	1	12	31	8

*Less than 0.5 percent.

TABLE 2. — Gullet and gizzard content of the Red-winged Blackbird from the cereal crop area north and east of Portage la Prairie, Man., in 1960
(Percentages of total volume of food)

Date	May		June		July		Aug.			Sept.		Oct.	Total
	11	24	7	24	5	19	2	19	30	13	27	11	
Number of Blackbirds	7	9	9	16	15	18	21	24	43	19	14	17	212
Total Volume of Food cc	—	9.4	14.3	22.4	30.1	26.6	40.6	34.0	81.9	49.7	63.1	53.7	425.8 Average
Vegetable Food													
Wheat	95	48	60	37	42	29	11	—	9	34	33	41	37
Oats	—	—	1	27	14	2	—	20	6	32	32	21	13
Barley	—	—	—	—	—	24	11	26	44	—	—	—	9
Wild oats	—	—	—	—	—	3	4	4	2	T*	T	14	2
Green foxtail	—	1	2	—	—	T	10	2	14	14	21	17	7
Wild buckwheat	—	—	T	T	—	T	T	1	T	T	T	1	
Sedge	—	—	T	—	—	—	4	1	2	T	2	T	0.5
Polygonum and Undetermined	T	1.5	—	—	—	T	—	—	1	T	—	T	
	95	51	63	64	56	58	40	54	79	80	88	94	68.5
Animal Food													
Snails	—	1	T	1	T	—	T	1	T	T	T	T	
Phalangida	—	2	—	—	3	—	1	1	2	—	T	T	0.5
Spiders	—	—	T	—	—	—	—	—	T	—	—	—	
Insects													
Odonata (Damselflies)	—	—	—	—	4	—	—	—	—	—	—	—	0.5
Orthoptera	—	—	—	T	7	19	32	5	0.5	3	—	—	5.5
Crickets	—	—	—	—	—	1	—	2	2.5	—	—	—	0.5
Lepidoptera	—	—	8	—	T	—	3	2	—	—	—	—	1.0
Coleoptera	1	15	14	31	5	2	2	T	T	T	T	T	6
Carabidae	T	17	2	—	—	—	—	—	—	—	—	—	2
Weevils	T	T	—	T	2	—	—	—	—	—	—	—	
Hymenoptera	—	T	T	—	—	—	—	2	5	T	T	—	0.5
Diptera	—	—	2	—	T	T	11	1	T	T	—	T	1.0
Incidental & Undetermined	T	T	—	T	20	8	4	2	T	T	T	T	3.0
	1	36	26	32	41	30	52	16	10	3	1	1	20.5
Mineral Grit													
	4	13	11	4	3	12	8	30	12	17	11	5	11

*Less than 0.5 percent

gizzards of birds taken on May 24. This had probably been picked up when the birds were migrating. Some of the birds taken on July 19 contained the dehulled seeds of a grass.

The main items of vegetable food in Areas I and II were wheat, sunflowers, oats, green foxtail, *Setaria viridis* (L.) Beauv., and barley (Tables 1 and 2). Wheat averaged 37 per cent of the food in Area II but only 6 per cent in Area I. Observations indicated that it was taken mostly as gleanings from the fields since only mature kernels were found in the stomachs until mid-July when the current crop began to ripen. After mid-September harvesting operations had been completed in virtually all fields. But wheat was also removed from the ripening heads in the late milk and dough stages. Sunflowers were very attractive to the blackbirds and made up 23 per cent of the gizzard contents of birds collected in Area I. Flocks concentrated on them from the time the kernels formed until the seed coat became too hard for them to break. They also consumed gleanings from threshed fields. Oats were eaten in the milk and dough stage and as gleanings. The hull was always removed. Green foxtail, which was abundant in most of the fields, was consumed in large quantities. Nine hundred and eighty-four seeds were found in one bird. Barley was eaten in the milk and dough stage. No evidence was found of barley being eaten after it was ripe. Sweet corn was eaten in gardens but field corn was not eaten to any extent except as gleanings. Fields of soup peas were visited for insects but the peas were not eaten.

Animal food was mainly insects and consisted mostly of pest species; grasshoppers e.g. *Melanoplus bivittatus* (Say) and *Camnula pellucida* (Scudd.); lepidoptera e.g., the larvae of the beet webworm, *Loxostege sticticalis* (L.); coleoptera e.g., the sweetclover weevil, *Sitona cylindricollis* Fabr., and the strawberry root weevil, *Brachyrhinus ovatus* (L.). The corn leaf aphid, *Rhopalosiphum maidis* (Fitch), the pea aphid, *Macrosiphum pisi* (Harr.), and the sugar-beet root aphid, *Pemphigus betae* Doane, along with their predators, lacewing larvae and syrphid larvae, were eaten. Carabid beetles were often consumed, particularly in the spring and fall. Recently emerged damselflies and chironomids were taken in the early summer. Spiders and harvestmen (Phalangida) were eaten to a limited extent throughout the season.

The soft parts of insects were quickly digested, but the hard parts, particularly the jaws and the chitinous plate found on each side of the knee of the hind legs of grasshoppers were retained for grit. One gizzard contained 44 jaws and 77 chitinous plates.

SUMMARY

In southern Manitoba the food of the Red-winged Blackbird consisted of up to 90 per cent vegetable material in the spring and again in the autumn. It was composed of the seeds of cereal crops, sunflowers, and weeds. In June and July, animal food, mostly insects, was dominant and represented up to 70 per cent in agricultural areas and 100 per cent in a large marsh. Young were fed entirely on animal food. When insect food increased, mineral grit decreased, its function apparently being carried out by the hard parts of insects.

TABLE 3. — Gullet and gizzard content of the Red-winged Blackbird from the marsh area at St. Ambroise, Man., in 1960

Date	May	June		July		Aug.		Total
	24	7	24	5	19	2	17	
Number of Blackbirds	6	5	7	7	7	2	2	36
Total Volume of Food cc	7.1	6.3	8.0	9.5	14.2	4.6	2.3	52.0
								Average
Vegetable Food								
Sunflower	0.5	—	—	—	—	—	—	T
Incidental and Undetermined	4.0	—	—	—	19	T*	T	3
	5	0	0	0	19	T	T	3
Animal Food								
Snails	T	T	T	1	T	T		
Phalangida	—	—	—	7	—	—		1
Spiders	1	T	9	—	—	T	T	1
Insects								
Odonata (Damselflies)	—	—	—	7	4	—	—	2
Orthoptera	—	—	—	34	28	99	99	37
Lepidoptera	26	47	14	11	—	—	—	14
Coleoptera	22	24	14	25	16	T	T	14
Carabidae	18	20	57					14
Diptera	13	8	6	14	19	—	—	9
Incidental & Undetermined	13	T	—	1.0	14	—	—	4
	93	100	100	100	81	100	99	96
Mineral Grit								
	2	0	0	0	T	0	1	0.5

*Less than 0·5%

Differences in the food items consumed by the birds in different areas were due to differences in local abundance of foodstuffs.

Food consumption per bird increased as the season progressed and in the autumn flocking period food was stored in the gullet.

Red-winged Blackbirds nested close to agricultural land when suitable sites were available. They also nested readily in large marshes remote from agriculture. In August and September they gathered in large flocks to feed in the fields. They required trees for resting and water for drinking close to a food supply. A suitable site for a night roost within a few miles of the feeding area was also essential.

The Red-winged Blackbird has adapted itself to changes brought about by agriculture and has benefited from an abundant food supply. It still utilizes nesting sites in remote marshes but appears to abandon them for cultivated areas as soon as the young are able to fly.

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ADDITIONAL RECORDS AND A CORRECTION OF THE TYPE LOCALITY FOR THE BOREAL CHORUS FROG IN NORTHWESTERN ONTARIO

FRANCIS R. COOK
National Museum of Canada, Ottawa, Ontario

COLLECTIONS OF AMPHIBIANS from northwestern Ontario are few and the present range maps are often inadequate for even the commonest species. This is particularly true for the Boreal Chorus Frog, *Pseudacris triseriata maculata* (the choice of scientific name for this form is discussed at the end of this paper). Logier and Toner (1961, p. 38) list and map its Ontario occurrences as: "*Cochrane Dist.*, Fort Albany (ROM). *Patricia Dist.*, Akimiski Island (PC: F. R. Gelbach). Fort Severn (ROM). *Rainy River Dist.* Emo (ROM)." One additional locality listed with the above but received too late to include on their map was "*Thunder Bay Dist.*, Connor Twp. (PC: A. E. Allin)." This should be corrected to O'Connor Township, which is 20-25 miles almost due west of Fort William (PC: A. E. Allin, August 15, 1963).

On the afternoon of May 20, 1963, the writer heard several Boreal Chorus Frogs calling from small roadside ponds 10 miles northeast on Hwy. 11 of Beardmore, Ontario. One specimen (NMC 7077) was collected at that time.

The area was boreal forest with tamarack, black spruce and aspen predominating. The chorus frogs were calling from three small, shallow grass-edged ponds in roadside clearings. The locality was revisited after dark and eight more specimens (NMC 7081) were obtained. Only about a half dozen additional individuals were heard calling. Other species collected at this area, in roadside ponds or along the nearby flooded edge of a small lake, were *Rana clamitans*, *Rana sylvatica* and *Hyla crucifer*. The latter was in full breeding chorus and 68 specimens were collected. Tiny *Rana sylvatica* tadpoles were taken still clustered around the disintegrating egg mass from which they had hatched. The afternoon had been warm and partly sunny but temperatures dropped rapidly during the evening and most of the collecting after dark was done during a light but steady snowfall.

A survey was made along Hwy. 11 to Geraldton by car, stopping periodically to listen for chorus frogs. They were heard at the following localities (recorded by nearest town and distance from it by Hwy. 11): Jellicoe, 1 mi. E. (few), 11.6 mi. E. (several); Geraldton, 13.7 mi. W. (few), 12.2 mi. W. (one), 0.8 mi. W. (one). Falling evening temperatures made an auditory survey east of Geraldton impractical.

The range extension to Geraldton diminishes, to some extent, the eastern gap between records from the western end of Lake Superior and those from James Bay. Geraldton is about 150 miles northeast of O'Connor Township and 290 miles southwest of Fort Albany.

It is interesting to note that during field studies in the Lake Nipigon area in 1921, 1922 and 1924 by E. B. S. Logier of the Royal Ontario Museum this species was not found (Logier, 1928). As his studies were made in June, July and August it is likely the species escaped notice because its breeding season had ended.

A few additional Ontario locality records are available. The Royal Ontario Museum has five unreported specimens from Halfway Point, Cochrane District, collected June 1, 1942. Halfway Point is listed in the Ontario volume of the Gazetteer of Canada (p. 226) as on the west shore of James Bay at 51° 54′ N., 80° 45′ W. This is a slight eastward extension of the range along James Bay from the published limit, Fort Albany, 52° 14′ N., 81° 36′ W. One ROM specimen from Goldpines, Patricia District, collected in 1935 had been previously cited by Smith (1956). The National Museum of Canada has three unreported specimens (NMC 7036) from Big Trout Lake, collected by D. H. Johnston, June 20, 1961. This is the village at 53° 49′ N., 89° 53′ W., 170 miles southwest of Fort Severn, rather than any of the numerous bodies of water in Ontario by that name.

Dr. A. E. Allin of Fort William, who is familiar with the call of this species, has kindly contributed the following auditory records: Rossport, April 18, 1938; April 28, 1939; April 11, 1941; April 23, 1946; May 25, 1946, and Fort William, May 2, 1946 (PC: August 15, 1963). Rossport, on Lake Superior, is 85 miles due east of Fort William and 67 miles southwest of Geraldton. It is the easternmost locality known for the subspecies along the north shore of Lake Superior. Dr. Allin (PC: October 3, 1963) has also provided additional

records of when the species was heard, usually the "first heard" of the year, from his series, *The Canadian Lakehead*, published in *The Flicker*. All of these records are from the Thunder Bay District and are as follows: April 10, 1955 (*The Flicker* 27(2): 88); April 22, 1956 (*The Flicker* 28(2): 75); April 20, 1958 (*The Flicker* 30(2): 62); April 26, 1959 [at Whitefish Lake] (*The Flicker* 31(2): 49); April 28, 1960 (*The Flicker* 32(3): 95); April 21, 1961 (*The Flicker* 33(3): 79). The Whitefish Lake locality is southwest of O'Connor Township. In addition, Mr. Kenneth Campbell of Peterborough had reported that he collected, recorded and photographed this species within the city limits of Port Arthur in 1949 and 1950, and that it was heard commonly all over the district (PC: August 24, 1963).

Dr. Allin (PC: October 3, 1963) also heard the species at Emo, April 26, 1951 (This record was noted in his article in *The Flicker* 24(2): 92-93, June 1952). On May 27, 1959, the writer heard it calling fairly continuously from roadside ponds and ditches while driving from Fort Frances to Kenora via Hwy. 71 and 70, and from Kenora to the Manitoba border via Hwy. 17. One specimen (NMC 4470) was collected at Dryden, June 28, 1960. The species was heard at numerous localities along Hwy. 17 from 23.3 miles southeast of Borups Corners to the Manitoba border, May 1, 1962. All of the above localities are shown in Figure 1.

The nine specimens collected 10 miles northeast of Beardmore (NMC 7077, 7081) vary in snout-vent length from 25 to 29 mm. The tibia divided by the snout-vent length gives percentages of 33 to 36 with a mean of 34.1%. The Dryden specimen (NMC 4470) had a snout-vent length of 27 mm with a tibia/snout-vent percentage of 37. These are well below the 39.3% mean for the tibia/snout-vent percentage reported for the short-legged Boreal Chorus Frog by Smith (1956). Specimens reported here were measured after they had been killed with ether and before they were preserved. They would be expected to average less than Smith's figures as the latter were taken from preserved specimens. Bleakney (1959, pp. 202-203) has pointed out that differential shrinkage is common in preserved specimens. However, the percentage is enough below Smith's figure to indicate agreement even allowing for differential shrinkage.

The eastern limit of the Boreal Chorus Frog is still to be determined. The night previous (May 19) to the collections reported here from the Beardmore-Geraldton area was spent at Hearst, about 150 miles northeast. Due to snow and cool temperatures no amphibians of any species were heard.

By retracing the field work back to May 16, it is possible to show a real hiatus between the Boreal and Western chorus frogs. The evening of May 18 was spent collecting in the area around Kenogami Lake (the northernmost of the three solid triangles in Figure 1). *Rana sylvatica*, *Hyla crucifer* and *Bufo americanus* were calling in large choruses. A few *Rana pipiens*, although not calling, were collected. The evening of May 17 was spent collecting along Hwy. 17, 13½ to 10½ miles south of North Bay (southeasternmost of the three solid triangles in Figure 1). *Hyla crucifer* and *Bufo americanus* were calling in large choruses. A few *Rana pipiens* and *Hyla versicolor* were calling, and

FIGURE 1. Distribution of Chorus Frogs in Ontario.
Boreal Chorus Frog (northwestern Ontario): solid circles = published records, half-filled circles = new records (museum specimens) reported in this paper, hollow circles = new auditory records reported in this paper.
Western Chorus Frog (southern and eastern Ontario): solid squares = published records from Logier and Toner 1961, hollow squares = auditory records reported in this paper. Solid triangles are localities in central Ontario given in the text where Chorus Frogs are known to be absent.

Rana clamitans and *Rana septentrionalis*, although not heard, were also collected. At both of these localities ideal weather conditions prevailed. If *Pseudacris* occurred in these areas it certainly would have been heard calling.

The evening of May 16 was spent at Renfrew, which is within the range of the other Ontario chorus frog subspecies, the Western Chorus Frog, *Pseudacris triseriata triseriata*. *Pseudacris t. triseriata*, *Hyla crucifer*, *Bufo americanus* and *Rana pipiens* were noted calling. The limit in eastern Ontario for the

Western Chorus Frog is at or near 7 miles southeast of Pembroke. On April 28-29, 1962, the writer noted *Pseudacris* calling from roadside ponds and ditches along Hwy. 17 from Ottawa to this point but not beyond (see Figure 1). Other known limital records for the Western Chorus Frog in Ontario are given by Logier and Toner (1961, pp. 36-37) and are shown in Figure 1.

Some additional evidence is available for the gap between the two Ontario subspecies of *Pseudacris* in central Ontario. On May 24, 1959, the writer heard a loud chorus of breeding amphibians from roadside ponds at 2.1 miles east on Hwy. 17 of Narin Centre (southwesternmost of the three solid triangles in Figure 1). *Hyla crucifer*, *Hyla versicolor*, *Rana pipiens* and *Bufo americanus* were represented but no *Pseudacris* were heard. Logier (1942) did not find *Pseudacris* in the Sault Ste. Marie, Ontario, region. C. Bruce Powell collected for the National Museum of Canada at Massey, Ontario, from August 24 to September 3, 1963, without finding chorus frogs, although 568 specimens of other herptiles were taken during this time. Unfortunately, both of the latter studies were carried out after the *Pseudacris* breeding season and auditory checks were not possible.

Available data strongly suggest that, although the eastern limit of the Boreal Chorus Frog is not yet known, its apparent separation from the closely related Western Chorus Frog in Ontario as shown on previous range maps (Conant, 1958; Logier and Toner, 1961) is real. Auditory surveys during the peak of the spring amphibian breeding season in the critical area between the presently known limits of the two subspecies will eventually establish the area of separation. As shown by Bleakney (1959) auditory surveys at this time give positive evidence for the presence or absence of *Pseudacris*.

Although Harper (1963) has recently expressed reservations on the validity of the Boreal Chorus Frog as a distinct subspecies, it is accepted here pending further study. Collection and analysis of several thousand specimens of this form from the Canadian Prairies, which should shed light on the problem, is in progress as part of a general study of that region.

Some Beardmore specimens in life exhibited the green color phase which is typical of many individuals from the Canadian Prairies. This color does not occur in several hundred Ontario *Pseudacris triseriata triseriata* which have been examined. Some specimens exhibit the spotted pattern which is fairly frequent in the northern form but rare in *triseriata*. Although neither of these characters seems taxonomically significant in separating these subspecies, they do emphasize a difference in their gene pools. The best character for separating this subspecies seems to be the tibia/snout-vent ratio as outlined by Smith (1956).

The correct scientific name for the Boreal Chorus Frog has been a matter of contention. Despite recent papers recommending nomenclature changes, Logier and Toner (1961) and Harper (1963) have retained the name *Pseudacris nigrita septentrionalis* Boulenger. Smith (1956) re-evaluated the range of the subspecies and pointed out that the subspecies name *maculata* Agassiz 1850 should supplant *septentrionalis* Boulenger 1882. A subsequent change in the species name became necessary when Schwartz (1957) presented evidence that

the *Pseudacris nigrita* complex should be treated as two species, *P. nigrita* and *P. triseriata*. The latter separation has been questioned but is, at least tentatively, widely used (e.g. Conant, 1958). Boreal Chorus Frog is a subspecies of the *Pseudacris triseriata* group.

The problem of *maculata* vs. *septentrionalis* centers around Agassiz's failure to record where he collected the specimens on which he based his description of *Hylodes maculatus* (*in* Agassiz and Cabot, 1850, pp. 378-379). Nor is there any indication of this locality in Cabot's narrative in the same volume (pp. 11-133). However, Cope (1899, pp. 345-346) in placing *Hylodes maculatus* in the synonymy of *Chorophilus triseriatus* gave a description based on "Professor Agassiz's typical specimen," and noted three specimens from "Lake Superior, north shore; Prof. L. Agassiz." ' Barbour and Loveridge (1929, p. 281) also gave the locality as "Lake Superior" and listed two specimens, number 38, as the types of *Hylodes maculatus*. They indicated that this name was a synonym of *Pseudacris nigrita*. Schmidt (1953, p. 75) placed the name in the synonymy of *Pseudacris nigrita triseriata* and restricted the type locality to "vicinity of Sault Ste. Marie." As Harper (1963) has pointed out there is no indication whether he intended it to apply to the locality in Ontario or the one in Michigan, and if he intended the Ontario locality the restriction is invalid as no *Pseudacris* are known from that part of Ontario.

As the specimens were collected from Lake Superior according to Cope (1889) and Barbour and Loveridge (1929) they must have come from the north shore at or east of about 20 miles west of Fort William, the most westerly point of the expedition according to Cabot's narrative (*in* Agassiz and Cabot, 1850, pp. 11-133). Specimens from this area were correctly assigned to the Boreal Chorus Frog by Smith (1956) and *maculata* must therefore replace *septentrionalis* as he suggested. Previous assignments of *maculata* to the synonymy of *nigrita* or *triseriata* are invalid. *Pseudacris* is known along the north shore of Lake Superior only as far east as Rossport, although it may yet be found farther east. Lacking any other evidence, the type locality has to be arbitrarily chosen from somewhere within this area. As the Boreal Chorus Frog occurs at Fort William and the expedition is known to have stopped and explored there (*in* Agassiz and Cabot, 1850, p. 80-88), the corrected type locality designated here is the vicinity of Fort William, Ontario. This correction is in accordance with Recommendation 72E of the 1961 International Code of Zoological Nomenclature which states (p. 77) that "If a type locality was erroneously designated or restricted, it should be corrected."

The correct name for the Boreal Chorus Frog is *Pseudacris triseriata maculata*. Its synonymy is that presented by Smith (1956) with the addition of the change in species name from *Pseudacris nigrita* to *Pseudacris triseriata* according to Schwartz (1957) and the type locality corrected to "the vicinity of Fort William, Ontario" of this paper.

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Particular thanks are due to R. A. Henry and C. Bruce Powell who assisted in the field in 1960 and 1963 respectively, and to Joyce C. Cook who prepared the map.

SUMMARY

Nine specimens collected 10 miles northeast of Beardmore on May 20, 1963, and auditory records between this point and Geraldton extend the range of the Boreal Chorus Frog eastward in northwestern Ontario. Additional records for northeastern Ontario, including Halfway Point, an eastern extension along James Bay, and Rossport, an eastern extension along Lake Superior, are reported.

The reported gap between the range limit of the Boreal Chorus Frog and the Western Chorus Frog is real as substantiated by three localities between the known range of the two subspecies where no *Pseudacris* were calling during observations at the height of the spring amphibian breeding period.

The nomenclatorial problem of the correct scientific name for the Boreal Chorus Frog is discussed and the name *Pseudacris triseriata maculata* is accepted. The erroneous type locality restriction of Schmidt (1953) is rejected and a replacement, vicinity of Fort William, Ontario, is designated.

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REVIEWS

The Last Horizon

By Raymond F. Dasman. The MacMillan Company, New York (Collier-MacMillan Canada Ltd., Toronto). 1963. vi + 279 pp. $8.00.

"There are many ways of life that remain with us today that seem already doomed unless some cogent reasons for maintaining them can be discovered . . . It is difficult, however, to attract people's attention to such problems as these under the present circumstances. . . . Our people are too baffled or too cynical to be much interested in a crusade, yet once more a crusade is needed, one to keep this world a fit place for people, all kinds of people."

At a time when the complexity of controversial issues often drives the professional biologist into a non-commital refuge of pure scientific objectivity, Dasman has penned a strongly crusading and self-admittedly opinionated summary of man's ever-increasing effects on his environment. He presents some straightforward reasons for restraints on the seemingly inevitable destruction of every last untouched refugia of the pre-civilized "natural" world.

From two thought-provoking introductory chapters which stress the rapidness with which man has accelerated his obliteration of the former landscape, Dasman traces the means and types of change and points out how often a single purpose has prevailed over a perspective of potential over-all effects. These chapters cover grassland, fire, introductions, forestry, arctic and boreal regions, the last wild game herds and islands. The two concluding chapters dwell on the human population explosion and the increasing world uniformity in habitat and culture. The coverage is necessarily brief but a thirteen page bibliography documents the text by chapters.

It is possible that books stressing the rate at which the destruction of the world flora and fauna is being accomplished and the need for strong measures for conservation are merely an exercise in futility in a world seemingly committed to discovering the maximum number of human beings that can be crowded onto a finite planet. However, *if* the tide can be stemmed, Dasman has produced an eloquent and readable contribution. It should be read by every biologist, naturalist, and "nature-lover", and perhaps especially by those in other spheres of interest with little previous inclination or sympathy toward conservation.

Francis R. Cook

Where is that Vanished Bird?

By Paul Hahn. 1963. Royal Ontario Museum, Toronto. 347 pp. $3.50.

The late Paul Hahn's deep interest in extinct birds goes back to 1887 when, as a 12-year-old boy living in Germany, he was appalled by the accounts of the shocking slaughter of Passenger Pigeons that was taking place in North America. Some years later he moved to Canada and, in 1902, when he first saw a mounted specimen of the Passenger Pigeon he was impressed by its beauty and saddened by the certainty that never again would anyone see the incredible flocks that once darkened the sun.

This was the beginning of a lifelong avocation of searching out and acquiring specimens of the Passenger Pigeon. He donated these to the Royal Ontario Museum where they are now safely preserved for scientific purposes. No less than seventy were acquired by Hahn, many of which were thus saved from eventual destruction by insects, fire, or neglect.

In 1957, he became curious to know how many specimens of the Passenger

Pigeon are preserved in other institutions and private collections throughout the world. He prepared and widely distributed a questionnaire requesting information on specimens of this and six other extinct, or nearly extinct, North American bird species. In the course of five years he received over one thousand replies which showed the following numbers of specimens preserved as skins or mounts, or as skeletons, in various parts of the world:

Passenger Pigeon (1532; also 16 skeletons); Eskimo Curlew (365; 2 skeletons); Great Auk (78; 2 skeletons); Ivory-billed Woodpecker (413; 5 skeletons); Whooping Crane (309; 8 skeletons); Carolina Parakeet (720; 16 skeletons); Labrador Duck (54; no skeletons).

The book gives all the basic data furnished by the owners concerning each specimen, including (when known) the name and address of the present owner, catalogue number, sex, collecting date and locality, and name of collector. In the case of many specimens of the Great Auk and Labrador Duck extensive historical notes concerning the individual specimens are given. This valuable and interesting record of vanishing data is an appropriate memorial to the enthusiasm and dedication of Mr. Hahn, who died on July 20, 1962.

W. EARL GODFREY

Fishes of the Western North Atlantic

By H. B. BIGELOW, M. G. BRADBURY, J. R. DYMOND, J. R. GREELEY, S. F. HILDEBRAND, G. W. MEAD, R. R. MILLER, L. R. RIVAS, W. C. SCHROEDER, R. D. SUTTKUS, V. D. VLADYKOV. Memoir of the Sears Foundation for Marine Research, New Haven. Number 1, Part 3, 1963 (?1964), 630 pp., 129 fig., 2 maps, $27.50.

The most recent part of this monumental work has just been issued. The text quality of the preceding volumes has on the whole been maintained. The extensive descriptions and synonymies, the carefully constructed keys, and the figures of adults and in some cases larvae will make this work the starting point for much future research.

The reviewer's general comments are few. Some authors have neglected to examine as large or as geographically extensive a series of specimens as might be desirable. In several sections a regional bias is exhibited. Most of the characters in the descriptions of some families (Engraulidae, Clupeidae, Elopidae and Albulidae) are external. In some species descriptions, characters which the author should have examined himself are given from the literature, e.g. "Branchiostegal rays 10-11 reported." (p. 509), "Pyloric caeca, average 38.4 reported." (p. 527). Common names are capitalized.

Some minor errors have crept in. Branchiostegals *are* present in some fossil Dipnoi and one *is* present in acipenseroids; the polyodontoids lack the subopercular (p. 5, etc.). A small gular *is* present in *Albula* (p. 132). *Clupea harengus* is the type-species of the genus *Clupea* not "by implication (unquestioned)" but by selection by Gill, 1861. The types of some of the other genera are not correctly cited.

In this volume are included the orders Acipenseroidei, Lepisostei, and in part, the Isospondyli. The long sections on the Atlantic salmon, Arctic charr, brook charr and tarpon will be of particular interest to the angler.

Although the part is dated 1963, the reviewer did not receive his copy until 1964. The most recent reference found in a quick perusal was 1961. It is to be hoped that future manuscripts will be published more rapidly although the task in a multi-authored volume is not easy.

Another problem is the rising price of the volumes. The first was $10, the second $15; the present one is $27.50. At the present rate of price increase and since less than one-quarter of the fishes are yet covered, only millionaires will be able to buy the last volumes! While the volumes are large and use the finest

paper and binding, they do not have coloured plates and are published in large editions; therefore one would think that $27.50 per volume is somewhat excessive.

Despite the high price, it is an essential reference for the working ichthyologist. Its style renders it readable to the intelligent amateur. It would grace the shelves of both.

D. E. McALLISTER
National Museum of Canada
Ottawa, Ontario

Fish and Wildlife: A Memorial to W. J. K. Harkness

Edited by J. R. DYMOND. Longmans Canada Ltd., Toronto. 214 pp. Frontispiece. $6.00.

Among the contributions of the fifteen authors are: *The naturalist in modern society*, *The need for a habitat*, *Animal numbers and behavior*, *The fisheries of the Great Lakes*, *How are fisheries managed*, *A philosophy of conservation*, and *The footsteps of a sportsman*, as well as sketches of Harkness. Among the notable scientists and authors who contribute are Gregory Clark, J. R. Dymond, W. E. Ricker, Dennis Chitty, E. J. Fry, W. M. Sprules and C. H. D. Clarke. The variety of topics bespeaks the breadth of W. J. Harkness' interests.

Despite the shortness of the articles each adequately covers its topic. Despite the diversity in authors the editor has managed to infuse a unity of style. Technical problems of limnology and population dynamics are discussed in clear English. The writing is almost error free, and is free of sentiment.

The vignettes of the man and articles on fish and wildlife will provide several evenings of pleasant and thoughtful reading.

The book is a fine and useful tribute to the memory of W. J. K. Harkness.

D. E. McALLISTER
National Museum of Canada
Ottawa, Ontario

Rowan Field Notes — A Review

When Dr. Wm. Rowan died on June 30, 1957, he left a considerable amount of unpublished written material, much of it pertaining to the ornithology of the province of Alberta. Some of this was purchased by the University of Alberta and deposited in the Library of that institution. Among it were his journals, contained in a series of volumes entitled "Ornithological and other notes by Wm. Rowan". These journals cover the period from 1908 to June 5, 1957; the entries for the first few years however, are quite brief and apparently were made from recollections at a later date. The earlier volumes especially contain much illustrative material in the form of sketches, wash drawings, and photographs. Each of the volumes is indexed. Some of the volumes cover periods of more than one calendar year and many of them do not begin and end with a calendar year.

A typewritten transcription of these journals has been made and, under the title "Rowan Field Notes", has been bound into six volumes. Volume I includes notes of the period 1908 - May 15, 1921; Volume II, May 16, 1921 - Oct. 22, 1929; Volume III, Mar. 17, 1930 - Dec. 11, 1935; Volume IV, Feb. 15, 1936 - Jan. 4, 1943; Volume V, Jan. 14, 1943 - Dec. 29, 1951; and Volume VI, Jan. 4, 1952 - June 5, 1957.

The transcription is a reasonably good but not an exact copy of Rowan's Journals. It contains some omissions of words and phrases and many errors of spelling, grammar and English, many of which reflect the inability of the transcriber to read Rowan's handwriting or to understand his scientific and colloquial expressions. The original journals of course, are not entirely devoid of such errors. Illustrative material is not copied into the transcription but a short verbal description of each illustration appears in its place. The volumes are well bound but the transcription, which was not

initially intended for publication, is on unsuitably flimsy paper.

During the first years of his residence in Alberta, Rowan was an enthusiastic field-man whose major interest was the shorebirds. At that time these birds occurred on migration in great abundance and variety at Beaverhills Lake about 50 miles east of Edmonton. Here he camped during the migration periods making observations and collections of skins. His field notes for this period are quite comprehensive reflecting perhaps the enthusiasm engendered by sights new to him. These early journals are of particular interest since they provide present-day ornithologists with some basis for comparison. For example, Rowan, who never missed the spectacular, gives only passing mention to Snow Geese in the 1920's while today they stop over in the area in tens of thousands. His interest in the shorebirds also led him to the muskeg areas northwest of Edmonton where he found snipe, dowitchers, and Greater and Lesser yellowlegs nesting.

In later volumes one can trace changing enthusiasms, taxonomy being on the wane and physiology in the ascent. There are references to the canaries and juncos caged in his backyard for early experiments on the effects of changing light and activity periods. His stories of attempts, not always successful, to capture crows to prove his hypothesis are sometimes amusing, sometimes almost pathetic. Descriptions of his experiments are not included. Still later his interest in cycles of abundance of some bird and mammal populations is evidenced by lists of weights of game birds taken by himself and his friends. At this time descriptions of hunting expeditions form a large part of the journals.

One does not read far before realizing that Rowan was inclined to overlook or ignore certain groups of birds. If the journals are any indication there are some species not uncommon in Alberta which rarely if ever came under his observation. The passerines in general receive little attention; one may look in vain in some volumes for mention of warblers, thrushes, or flycatchers. Birds of prey, which were still abundant when he arrived in Alberta, receive little more than passing mention. Records of numbers are rarely precise and seem at times devoid of the objectivity expected of a scientist.

Among the ornithological notes are interspersed numerous references to his family, his friends, his acquaintances and his pets. Characteristically his pithy comments usually serve to give a more vivid picture of their author than of their subjects, often revealing unexpected facets of his personality. His opinions are expressed freely and forcefully. Rowan was not one to sit on a fence.

It is doubtful that the Rowan journals will be published in any but this present form. Copies of the typewritten transcription bound in six volumes have been placed on the shelves of the Library of the University of Alberta. They form a part of the regular Library collection and are made available to readers under the usual Library regulations.

W. RAY SALT

Department of Anatomy
University of Alberta
Edmonton, Alberta

OTHER NEW TITLES

Queen Elizabeth Island Game Survey 1961

By JOHN S. TENER, Canadian Wildlife Service Occasional Papers No. 4. 1964. 50 pp. + map. (Queen's Printer, Ottawa).

Age Determination in the Polar Bear

By T. H. MANNING. Canadian Wildlife Service Occasional Papers No. 5. 1964. 12 pp.

A Wildlife Biologist Looks at Sampling Data Processing and Computers

By DENIS A. BENSON. Canadian Wildlife Service Occasional Papers No. 6. 1964. 16 pp.

Rabiolaria in Plankton from Arctic Drifting Station T-3, Including the description of three new species

By KUNIGUNDE HÜLSEMAN. Arctic Institute of North America. Technical Paper No. 13. 1963.

The Peacock Camping Book
By REX HAZLEWOOD and JOHN THURMAN. A Peacock Book. 1964. (Available in Canada through Longmans Canada Ltd.). $0.85.

Birds of the Detroit-Windsor Area: A Ten-Year Study
By ALICE H. KELLEY, DOUGLAS A. MIDDLETON, WALTER P. NICKELL and THE DETROIT AUDUBON SOCIETY BIRD SURVEY COMMITTEE. Cranbrook Institute of Science. Bulletin 45. 1963. 119 pp. $1.00.

Stefansson: Ambassador of the North
By D. M. LEBOURDAIS. Harvest House, Montreal. 1963. 204 pp.

Contributions to Zoology, 1963
National Museum of Canada Bulletin No. 199. 109 pp. $1.50. (Queen's Printer, Ottawa).

Contents:

P. C. Adshead, G. O. Mackie and P. Paetkau, *On the Hydras of Alberta and the Northwest Territories;*

Arthur H. Clarke, Jr. and Anne Meachem Rick, *Supplementary records of Unionacea from Nova Scotia with a discussion of the identity of* Anodonta fragilis *Lamark;*

Edward B. Reed, *Records of freshwater Crustacea from Arctic and Subarctic Canada;*

George O. Mackie and Gillian V. Mackie, *Systematic and Biological notes on living Hydromedusae from Puget Sound;*

D. E. McAllister and E. I. S. Rees, *A revision of the Eelpout Genus* Melanostigma *with a new genus and with comments on* Maynea.

NOTES

Occurrence of Some Small Mammals in Southwestern Ontario

FROM AUGUST 24 TO AUGUST 29, 1963, my wife Claudine F. Long and I visited southwestern Ontario to collect mammals. Collections were made in the vicinity of English River (August 26); three miles west of Dryden (August 27); and one mile south and ten miles east of Kenora (August 29). All of the localities are in Kenora District. Habitats were chiefly characterized by numerous moist situations where grasses and sedges were abundant and by the presence of spruce, fir, and birch growing abundantly on high ground. Lake-shore habitats were investigated at English River and in the vicinity of Kenora. Cleared marshy fields were investigated west of Dryden, as were woods on high ground (the latter with no success). I am grateful to my wife for helping with the field work and to Professor Donald F. Hoffmeister for examining manuscript and for his suggestions. All specimens are in the Museum of Natural History, University of Illinois. Kinds of mammals obtained in this study are listed as follows:

Sorex palustris palustris Richardson:

This shrew is seemingly rare in western Ontario (Cahn, 1937, Journal of Mammalogy 18: 21), but is known from Quetico Provincial Park. Another record is from Michipicoten Island, in Lake Superior (Jackson, 1928, North American Fauna 51:180). Anderson (1947, National Museum of Canada Bulletin 102, p. 20) states that *S. p. palustris* occurs in western Ontario. Two specimens (28829-28830, ? females) of this subspecies were obtained from the shore of Brown's Lake, English River, Ontario. They were taken within two meters of the water in dense timber, mainly birches. Both were molting, and the pigmentation on the undersides of their skins showed molt extending from nose to eyes to pinnae to sholders to tail in 28830. In 28829 the pattern was similar except that immediately anterior to the eyes there was no evidence yet of molt, although a distinct spot of pigmentation showed evidence for molt immediately behind the nose.

Tamias striatus griseus Mearns: A. H. Howell (1929, North American Fauna 52:21) recorded the eastern chipmunk from Ingolf, Ontario. To the eastward (as near as Kapuskasing) Cameron (1950, Journal of Mammalogy, 31:347-348) assigned records of occurrence to *T. s. quebecensis*. A marginal record of occurrence for the species is provided by a specimen (28835) from one mile south and ten miles east of Kenora. This specimen is indistinguishable from specimens of *griseus* from Minnesota, Wisconsin, and Illinois, except that the mid-dorsal black stripe is wider and less obscure on the Canadian specimen than on some specimens from Illinois. The Kenoran chipmunk was trapped among weathered outcrops in coniferous forest approximately 100 yards from a lake.

Eutamias minimus neglectus (J. A. Allen): Three specimens (28837-28839) of the least chipmunk were taken 2-2½ miles west of English River in glades in coniferous forest. One chipmunk (28840) from one mile south and ten miles east of Kenora was trapped in sedges and grasses one meter from the shore of a lake. This grassy habitat was adjacent to sparse coniferous forest where another least chipmunk was observed. *Tamias* and *Eutamias* occur together in the forest at this locality.

Tamiascirus hudsonicus hudsonicus (Erxleben): The red squirrel, or chickaree, was seen or heard at all of the trapping localities. One (28841) was found dead on a highway five miles west of English River.

Peromyscus maniculatus maniculatus (Wagner): Concerning the deer mouse, Osgood (1909, North American Fauna 28:41-45) ascribed southern Ontario to the geographic range of *P. m. maniculatus*, indicating that this subspecies intergraded with *gracilis* in northern Minnesota. The latter subspecies is characterized by long tail, narrow skull, and bright upper parts; therefore, it is surprising that Gunderson and Beer (1953, *The mammals of Minnesota*, Occasional Papers of the University of Minnesota, Museum of Natural History 6:104-105) refer without comment ten specimens to long-tailed *gracilis* inasmuch as their measurements do not fit with those recorded by Osgood for *gracilis*. Of additional interest are the nine specimens (referred to *gracilis* by Osgood) obtained from Tower, Minnesota, having short tails. These assignments are supported by Cahn (1937, Journal of Mammalogy 18: 26), who listed *gracilis* from Quetico Park. On the basis of dull upper parts, broad skulls, and tails shorter than usually seen in specimens of *gracilis*, three specimens (28843-28845) of the deer mouse from one mile south and ten miles east of Kenora are assigned to *Peromyscus m. maniculatus*. Their close resemblance to specimens from northern Minnesota is noted, and their external measurements are as follows: Total length, 184, 177, – (subadult); length of tail, 91, 90, 89; hind foot, 20, 20.5, 20; ear from notch, 18, 18, 17. A subadult (28842) from two miles west of English River is provisionally assigned to *P. m. maniculatus* on geographic grounds. External measurements are: 155, 80, 20, 19.

Clethrionomys gapperi gapperi (Vigors): One specimen (28846) of the red-backed vole taken two miles west of English River, contained the record number of eight foetuses (Hall and Kelson, 1959, The Mammals of North America, 2:713). Each measured approximately 22 mm in crown-rump length. Another specimen (28847) from one mile south and ten miles east of Kenora was lactating. Both voles were taken in dense coniferous forest.

Microtus pennsylvanicus drummondi (Aud. and Bach.): The meadow vole was abundantly taken in grassy habitats. Two specimens were taken from two miles west of English River; seven were

taken three miles west of Dryden; and three were taken one mile south and ten miles east of Kenora.

Synaptomys cooperi cooperi Baird: A specimen (28863) of the southern bog lemming from one mile south and ten miles east of Kenora provides a marginal record of distribution for the species, the second for southwestern Ontario (*see* Wetzel, 1955, Journal of Mammalogy, 36:13). The bog lemming was trapped in dense coniferous forest among ferns, mosses, and weathered rock-outcrops.

Zapus hudsonius hudsonius (Zimmermann): The meadow jumping mouse was abundant among sedges and grasses within two meters of bogs, lakes, and streams. Specimens were taken as follows: two miles west of English River, 2; three miles west of Dryden, 1; one mile south and ten miles east of Kenora, 4.

CHARLES A. LONG

Department of Zoology
and Museum of Natural History
University of Illinois
Urbana, Illinois
2 December 1963

Black Duck Breeding Record for Alberta

WHAT IS BELIEVED to be the first breeding record for the Black Duck (*Anas rubripes*) in Alberta was obtained in the vicinity of Hanna (9 miles north and 3 east), on June 9, 1963, when Angus Gavin, General Manager of Ducks Unlimited (Canada) and Fred Sharp, Provincial Naturalist for the same organization, saw a female Black Duck with a brood of 5 young, approximately 10 days old. The weather was clear with little wind. Identification was positive since the observers were able to approach within 100 feet of the duck and brood. Eight-power binoculars were also utilized.

The brood was on the creek channel immediately below the Ducks Unlimited Mattis Project. Water is maintained in the channel from a small pipe through the dam. The surrounding area is typical of the treeless southern Alberta plains.

Taverner (1926, *Birds of Western Canada*) mentions the spread of Black Ducks westward, as do Salt and Wilk (1958, *The Birds of Alberta*). This has been apparent to waterfowl biologists working on the prairies. Black Ducks are now common in Manitoba during the hunting season and there are many reports from Saskatchewan and Alberta each fall.

WILLIAM G. LEITCH

Chief Biologist
Ducks Unlimited (Canada)
606-389 Main Street
Winnipeg 2, Manitoba
20 January 1964

Piping Plover in Ottawa, Ontario

ON AUGUST 24, 1950, the writer collected a male Piping Plover, *Charadrius melodus*, at Britannia Beach, Ottawa, Ontario. This is an addition to the birds of the Ottawa area and was not included in Lloyd's (1944, Canadian Field-Naturalist, 58:143-175) list.

A. E. BOURGUIGNON

979 Hare Avenue
Ottawa 13, Ontario
12 February 1964

Two Interior British Columbia Records for the Ancient Murrelet

ON JANUARY 20, 1964, Mr. O. W. Aastland, a Cranbrook, British Columbia taxidermist, asked me to verify his identification of a bird. On arriving at his place of business I was somewhat astonished to find a live Ancient Murrelet, *Synthliboramphus antiquus*, in typical winter plumage. Mr. Aastland informed me that this bird had been found that morning floundering in the snow near the western boundary of the Cranbrook city limits.

A discourse about this rather unusual occurrence prompted Mr. Aastland to produce from his deep freeze another

Ancient Murrelet in the flesh and in similar plumage, which he had picked up dead during the early winter of 1960, at a point approximately twenty miles north of the site of this more recent discovery.

As far as I am aware, there is only one published record of this bird for the British Columbia interior, viz., Swan Lake, Okanagan, October 26, 1939 (Munro and Cowan, 1947, A Review of the Bird Fauna of British Columbia). The appearance of this sea bird so far inland from the Coast Littoral Biotic Area, its natural habitat, leads to conjectures as to whether each occurrence inland had been immediately subsequent to a weather disturbance on the Pacific coast. The finding of this live Murrelet at Cranbrook on January 20, 1964, certainly suggests this, for press reports state that there were westerly winds of up to sixty-five miles per hour on the Pacific coast during January 19, 1964.

WALTER B. JOHNSTONE

P.O. Box 704
Cranbrook, British Columbia
28 January 1964

A Probable Breeding Record of the Bobolink at Vermilion, Alberta

ON JULY 29, 1961, a flock of Bobolinks, *Dolichonyx oryzivorus* (Linnaeus), was seen at Grizzly Bear Coulee near Highway 41, five miles south of Vermilion, Alberta. After observing the birds for about 45 minutes, the author was able to count five adult males, seven which were presumed to be adult females, and 17 recently fledged young. Most of the young had short tails, and uttered call notes characteristic of Bobolink young. A few of these birds could not fly more than 100 yards before dropping to the ground. Twice the author watched an adult female carry food to and actually feed one of the immature birds.

Several attempts were made to catch one of the young birds, but the wetness of the valley made running difficult, and it was impossible to exhaust any of them. However, these birds were such poor fliers that it is unlikely that they were born very far from the site of observation.

The A.O.U. Check-list of North American Birds (1957, Fifth Edition) reports that Bobolinks breed in southern Alberta, although no specific region is cited. Salt and Wilk (1958. *Birds of Alberta.* Queen's Printer, Edmonton) state that this species is scarce in the province, and that it is known to nest around Calgary, Heinsberg (approximately 35 miles northeast of Vermilion) and Camrose (approximately 65 miles west southwest of Vermilion). These authors suggest that it is almost certainly nesting in other regions of Alberta.

In the summers of 1957 and 1958, the author was in the temporary employ of the Canadian Wildlife Service to assist in waterfowl studies around Vermilion. During this time, there was no evidence of Bobolinks breeding in the area. Thus the observation of the flock of 12 adult and 17 flying young Bobolinks reported herein suggests that a breeding colony may have been established in a new locality in Alberta, namely Vermilion.

JAMES K. LOWTHER

Biology Department
Bishop's University
Lennoxville, Quebec
19 February 1964

Harris' Sparrow in Quebec

ON SEPTEMBER 29, 1957, an adult Harris' Sparrow, *Zonotrichia querula* (Nuttall), was caught at St. Laurent, Quebec. The bird was part of a flock of Song, Lincoln's and White-throated sparrows, and Swainson's and Gray-cheeked thrushes. These birds were casually moving through some hedgerows that mark the boundaries between farm fields. These hedgerows are composed of wild cherry,

hawthorn, elm, and ash trees which are overgrown with vines of Virgina creeper and wild grape. Some of the birds, including the Harris' Sparrow, were chased by the author and his wife into a Japanese mist net placed across an opening through a hedgerow.

The Harris' Sparrow was identified by its black cap, pink bill, and heavy black streaks on the upper flanks. The black throat and large amount of black on the crown distinguished it as an adult. The bird was taken back to Montreal alive, but unfortunately it escaped before it could be made into a museum skin. It was wearing band numbered 22-108480, with which it had been banded immediately after capture.

To the best of the author's knowledge, there are no previous records of Harris' Sparrow in Quebec. The *A.O.U. Check-list of North American Birds* (1957, Fifth Edition) shows that in eastern Canada, this species occurs occasionally around Toronto, Ontario. To the south, Harris' Sparrows have been reported during the winter and early spring from Connecticutt (Ball, 1946. Auk, 63: 448-450), and from Ingham, Ipswich, and Boxford in Massachusetts (Mason, 1949. Auk. 66: 95-96). The "in-hand" observation of the adult Harris' Sparrow reported herein appears to be an easterly record for this species in Canada, as well as a new record for the province of Quebec.

JAMES K. LOWTHER

Biology Department
Bishop's University
Lennoxville, Quebec
19 February 1964

Additional Specimens of the Small-mouthed Salamander from Pelee Island, Ontario

THE SMALL-MOUTHED SALAMANDER, *Ambystoma texanum*, was first reported for Canada by Uzzell (1962, Canadian Field-Naturalist 76(3): 182) on the basis of two previously misidentified museum specimens from Pelee Island, Ontario. The writer spent April 16-17, 1963, on Pelee Island and collected four additional specimens of this species. As these add to our limited knowledge of the Canadian population of *A. texanum*, they are reported here.

During the afternoon of April 16, areas of low, partially flooded woodland were searched for salamanders. Despite abundant cover in the form of rotting logs, no salamanders were found. The evening was cool and an auditory survey for frogs along the main roads of the island failed to detect any calls. About 9:30 p.m. a ditch at the south end of the island was carefully examined. It was deep and steep sided, bordered by bushes along the road edge and by open fields on the opposite side. At first no amphibians were seen or heard, but three salamander eggs (*Ambystoma*, sp.) were found in relatively shallow water along the ditch's roadside edge. One end of the ditch was fairly steeply banked like its sides, and was bordered by an area covered by a few scattered bushes and thick matted dead grass. Crayfish burrows were numerous. An adult *Ambystoma texanum* was discovered in the matted grass about three feet from the edge of the ditch. Careful search over the next half hour in an area up to about 30 feet from the edge resulted in the discovery and capture of three more adults. These specimens were apparently foraging, as all were more or less in the open.

Dissection has shown them to be two males and two females. The latter contain eggs indicating that breeding had not occurred. The measurements and proportions of these specimens (NMC 6904) are (in millimetres): *males* – total length 156, 143; snout-vent length 86, 79; tail length/total length ratio .449, .448; *females* – total 173, 169; snout-vent 101, 94; tail/total .416, .444. All specimens are larger in snout-vent length than the only adult, a 70 mm female, available to Uzzell (1962). All exceed the 4½-5½ inches given by Conant (1958, *A Field*

Guide to Reptiles and Amphibians, p. 211) as the usual range of total length, but none approach his maximum of 9¼ inches. All had 15 costal grooves counting one over each limb, or 13 if only those between the limbs are counted. The colour was bluish black to slightly brownish in life. In three specimens the sides were a light bluish grey giving them a more or less evenly frosted appearance. In one specimen the bluish grey was broken into lichen-like markings on the sides and back. The sides of the tails were variously frosted or lichen-marked with bluish grey. The venters were black. In two specimens they were marked with bluish grey lichen markings and the throat and chin were solid bluish grey. In the other two the venter was marked with a few irregularly shaped bright blue spots and the throat and chin were also spotted with blue. In preservative all markings have faded so that they are nearly indistinguishable from the ground colour. The relative smallness of the mouth and head characteristic of this species is evident in all specimens. Tooth and tongue characters agree with those given by Uzzell (1962).

The three *Ambystoma* eggs collected (NMC 6944) were in an advanced stage of development. The embryos measured approximately 6 mm and had three prominent gill stubs on each side of the head. Both front and rear limb buds were evident. The jelly capsules were large, and the diameter of the eggs were 12, 11 and 9.5 mm after preservation. According to Bishop (1943, *Handbook of Salamanders*, p. 158) the eggs of *A. texanum* may be deposited singly or in small clusters. *A. laterale* which has been recorded from Pelee Island as well, also occasionally lays single eggs so that assignment of this collection is not possible. It is likely that the eggs were laid in late March or early April as southern Ontario had a period of warm spring temperatures at that time and the eggs are well advanced. If they were laid by *A. texanum* a breeding season of more than two weeks is indicated for the species on Pelee Island.

The only other amphibian seen was a single Blanchard's Cricket Frog, *Acris crepitans blanchardi* (NMC 6905), 22 mm snout-vent, collected in water at the end of the ditch after the last of the salamanders had been taken.

FRANCIS R. COOK
National Museum of Canada
Ottawa, Ontario
27 February 1964

Nest-Site Competition between Bufflehead, Mountain Bluebird and Tree Swallow

SEVERAL EXAMPLES OF INTERACTIONS between hole-nesting birds were observed in the Cariboo district of British Columbia, in the summers of 1958 and 1959 (Erskine, 1959, Canadian Field-Naturalist, 73:131, and 1960, 4:161-162). Observations at a nest, in a poplar tree at Watson Lake near 100 Mile House, are outlined in Table 1.

The Mountain Bluebird, *Sialia currucoides*, was remarkably persistent in rebuilding its nest after the nest material was removed and scattered. Suitable nest-holes were numerous in that area, although the rapidly increasing population of Starlings, *Sturnus vulgaris*, occupied a large proportion of available sites in 1958. The bluebird built a complete nest and laid one egg between our visits on May 17 and 20. Perhaps the need to lay may have prompted such feverish nest-building activity.

The 14 Bufflehead, *Bucephala albeola* eggs were laid over a period of nearly one month. The laying sequence up to May 14 was normal for Bufflehead, but the addition of only two eggs in the next nine days suggested that a second bird had been involved. Measurements of the eggs (Erskine, 1960, M.A. thesis, University British Columbia, p. 45 and Figure 9) suggested that at least eight of the first 11 eggs were laid by one bird, and two by another. The last three eggs

TABLE 1.—Contents of nest cavity on visits during May and June, 1958

Date	Contents of cavity, and remarks
6 May	Female Buff.* on nest, contents unknown.
7 ,,	4 Buff. eggs, cool.
9 ,,	5 Buff. eggs, cool, under grass nest; grass was removed.
14 ,,	9 Buff. eggs, cool, at several levels in dry grass of nest; grass was removed.
17 ,,	9 Buff. eggs, cool, under grass nest; grass was removed.
20 ,,	1 Mountain Bluebird egg in grass nest; 10 Buff. eggs under and in lowest layers of grass.
23 ,,	1 Buff. egg in grass nest; Bluebird egg broken through grass; 10 Buff. eggs under grass; grass was removed.
3 June	Buff. eggs (not counted), warm, in grass nest.
8 ,,	Female Buff. (caught and banded) on 3 Buff. eggs in grass nest.
12 ,,	3 Buff. eggs and 1 Tree Swallow egg, warm, in grass nest; 11 Buff. eggs, cold and dirty, under grass.
16 ,,	2 adult Tree Swallows on nest; contents as on 12 June.
19 ,,	1 Swallow on nest; contents unchanged.
21 ,,	1 Swallow on nest (caught and banded); contents unchanged.
23 ,,	1 Swallow on nest; contents unchanged.
30 ,,	No Swallows seen; eggs cold; no further activity observed.

*Buff. = Bufflehead

were probably laid by a third individual, although the measurements were comparable to those of the first eight eggs.

The most remarkable feature of the nesting was the Tree Swallow, *Iridoprocne bicolor*, incubating the Bufflehead eggs. Incubation lasted from not earlier than June 9, until sometime after June 23, a period similar to that normally found for the swallow. When the three Bufflehead eggs that had been covered by the swallow were opened, one embryo that was judged to be about one-third term (feather tracts readily apparent but feathers not yet erupted) was found. The other two eggs were undeveloped. Evidently the swallow was able to supply sufficient heat to permit development of the egg, at a rate not markedly different from that in normal Bufflehead nestings. The normal incubation period for Bufflehead is 30 days, so one-third term would be about ten days. Those eggs were under the swallow for at least 11 days (June 12-23), but possibly longer.

A. J. ERSKINE

Dept. of Zoology
University of British Columbia
Vancouver 8, B.C.
27 February 1964
(Present address:
Canadian Wildlife Service
Sackville, New Brunswick)

Notes on Townsend's Solitaire in Western Chilcotin District, British Columbia

THE FOLLOWING is derived from observations of the Townsend's Solitaire, *Myadestes townsendi*, extending over fourteen years and involving seventy-five nests (all of which were at elevations between 2800 and 3000 feet above sea level).

The nests seen by this observer have, with one exception, been built in cutbanks beside a road or trail. A favorite position is a foot below the top of the cutbank with a few branches of kinnikinick (*Arctostaphylos Uva-ursi*) hanging down over it. Some nests are within ten feet of cars and trucks passing at the rate of about four per hour. It would seem that, like Robins and Mountain Bluebirds, Solitaires sometimes prefer to risk proximity to man for the sake of reduced danger from predators. However, one nest was found in a natural crevice in a riverside cliff.

Incubation does not exceed fourteen days. About 40 per cent of nests are destroyed by predators, by which sometimes eggs are removed without the nests being damaged; at other times the

nest is crushed and eggs or young destroyed. It is probable that human predators are very scarce here. The first eggs are usually laid between May 18 and 25. If a nest is destroyed a second clutch will often be started, but eggs are seldom laid after June 15.

Occupation of territories (perhaps a hundred yards of cutbank) yearly for three or four years points to the same birds returning year after year; sometimes in fact the nest is rebuilt in the same spot as last year. If a nest is destroyed early in the season it is a safe assumption that a second nest will be started in the same territory.

About one out of four nests has five eggs, most of the remainder four eggs; occasionally a second nest has only three eggs. On one memorable occasion a pair raised one brood and immediately laid a second clutch in the same nest.

The eggs have spots in one of two patterns, namely scattered fairly uniformly over the entire surface, or alternatively forming a loose ring near the larger end.

From the laying of the first eggs to the vacating of nest by the nestlings is usually about twenty-nine days. Some young stay in the nest until well feathered; in other cases they leave before they can fly more than a few feet. On one occasion when young had just left a nest and were hidden in some bushes, both parents hovered closely above my dog and turned him aside.

No Solitaire nest, to my knowledge, has ever contained a Cowbird egg, although there are usually some of these birds in the vicinity.

About five per cent of Solitaire eggs fail to hatch, probably in most cases due to being exposed to direct sunlight. On one occasion the female (and male?) continued to attempt to incubate a clutch of eggs for such a long time that after they had abandoned the nest it was found that the eggs were dehydrated to such an extent that the air space occupied two-thirds of the egg; in fact if you placed the egg on a smooth surface it insisted on standing on end. The germ was found to have died about the second day of incubation. It was thought that in this case cattle feeding or resting close to the nest may have kept the hen away from the nest for too long a time.

The beautiful song is usually heard continuously for about seventeen seconds, early in the morning, for a few days only, starting at the end of April. When a first nest is destroyed there may be a renewal of singing prior to the second clutch of eggs. Singing birds usually perch on or near the top of a pine tree, but on one occasion I observed a bird singing several times while a strong wind carried it upwards a hundred or more feet above the top of a steep hillside. It is thought that our western Chilcotin Townsend's Solitaires spend the winter at or near sea level along the coast and islands of British Columbia.

W. ADRIAN B. PAUL

Kleena Kleene, British Columbia
2 March 1964

Notes on the Birds of Riding Mountain National Park, Manitoba

DURING THE COURSE of range management studies in Riding Mountain National Park, Manitoba, in 1962 and 1963, incidental observations were made of the local bird fauna. Only the more significant observations, which supplement bird lists prepared by Taverner and Sutton (1940, National Museum of Canada, unpublished manuscript 20 pp.) and Soper (1953, Canadian Wildlife Service, Wildlife Management Bulletin, Series 2, No. 6, 54 pp.) are recorded here. Considerable time was spent in the park in the summers of 1962 and 1963, and periodic visits were made during the intervening winter. All observations were confined to the area of the park west of Highway Number 10.

Aix sponsa, WOOD DUCK

On September 29, 1962, a male Wood Duck was seen on a beaver pond among heavy aspen forest about two miles south

of Gunn Lake in the west-central part of the park. According to Taverner (1949, *Birds of Canada*, Musson, Toronto, 446 pp.) the Wood Duck is " . . . rare or absent throughout the prairies, occasional in southeastern Manitoba . . " Thus the present record, 130 miles north of the International Boundary and only 40 miles east of the Manitoba-Saskatchewan boundary, is somewhat northeast of the usual range of the species. The nearest published Wood Duck records appear to be those of Taverner (1919, Ottawa Naturalist, 32(8):142) and Seton (1908, Auk, 25:450-454) who reported that local residents occasionally saw Wood Ducks at Shoal Lake, about 35 miles northwest of Winnipeg.

Bucephala albeola, Bufflehead

Soper did not see Buffleheads in summer and remarked that they are uncommon in the park at all times. On July 6, 1962, I observed two females on a beaver pond in Birdtail Creek. That was my only summer observation of this species.

Cathartes aura, Turkey Vulture

Although not observed by Soper and listed as an "occasional casual visitor" by Taverner and Sutton, seven observations of Turkey Vultures were made between June 15 and October 20, 1962, and three between May 4 and September 17, 1963. Several of those observations were of pairs. All were seen between Lake Audy and the west park boundary.

Pandion haliaetus, Osprey

According to Soper (1953) the Osprey is "a rare visitor where it has not been recorded during spring and summer". His only park record was made on October 7, 1946. On May 23, 1962, in the company of park warden George Klapp, I observed a pair of Ospreys fishing at Bob Hill Lake near the west end of the park. They were not seen on subsequent visits to the area so presumably did not stay and breed.

Coccyzus erythropthalmus, Black-Billed Cuckoo

This species is rare enough in the Riding Mountain area to warrant the recording of observations near Bob Hill Lake, Baldy Lake, and Moose Lake on July 9, July 12, and August 9, 1962, respectively. Two of those observations were of pairs (July 9 and 12), the other was a single bird.

Surnia ulula, Hawk Owl

On two occasions in November, 1962, Hawk Owls were seen in parkland habitat in the Birdtail Valley near the west end of the park. Taverner and Sutton (1940) listed this species as a "probable winter visitor" but did not observe it. Soper does not list it. Riding Mountain falls within the general winter range of this owl listed by Taverner (1949) as "most of Southern Canada".

Petrochelidon albifrons, Cliff Swallow

The distinctive nests of this swallow were seen during the summer of 1962 on a shed and house at the Deep Lake Warden Station, near the west park boundary. Young Cliff Swallows were fledged there that summer, but no members of this species appeared there in 1963. Soper does not list this species and Taverner and Sutton (1940) did not observe it at Riding Mountain, but remarked that it should occur as a migrant or nester.

Sturnus vulgaris, Common Starling

Several starlings were seen in April and May, 1962 and 1963, in the Birdtail Valley, but they did not appear to remain there to breed as none were observed during the summer. It is not known how recently starlings moved into the Riding Mountain area but they may have been in the region for several years, since they reached southern Manitoba from the east about 1934 (Myers 1958, Occasional Papers B.C. Provincial Museum, No. 11, 60 pp.). However, Soper did not include this species in his 1953 list.

Donald A. Blood
Canadian Wildlife Service
Edmonton, Alberta
2 April 1964

Letter to the Editor

Dear Mr. Editor:

It takes a while for the slicks to get up our way, but a copy of your magazine arrived with the last load of strychnine capsules from Ottawa, and I got to reading it, and I can't say it makes me too happy.

I don't think Major Banfield has been as kind to Captain Mowat as he might have been. Not that I want to defend any of your two-legged monstrosities, but fair is fair. He hasn't been too kind to me either – or to the rest of the family. You can get used to strychine (I guess Capt. Mowat ain't much of a chemist – him and his cyanide) but it takes time. One thing though, it seems to stretch out a wolf's life. And how does Captain Banfield know how long a wolf lives anyway? Has he been one? Or has he just got himself fouled up in a bunch of statistics from the Ottawa Zoo. The animal zoo, I mean. Not the big one.

Anyway, fair is fair, and since Major Mowat won't speak for himself – a shy fellow, he is, I guess its up to me. That caribou plan, for instance. Leut. Banfield ought to remember that the whole idea of the Caribou survey was originated by Lt. Col. Mowat the year before Sgt. Banfield ever heard of it. It was presented to the Arctic Institute in the faint hope that some money might be forthcoming. None was. But the Federal Government (wolf-haters, the lot of them!) decided that it was too big a project for individuals, and took it over. So far as I known Brigadier Mowat never let a peep out of him when Cpl. Bandield took over the whole scheme, including the complete plan of operation as devised by General Mowat and a fine, forgotten fellow named Andrew Laurie who actually did most of the work, and never did get any credit at all. If I was Oberlieutnant Mowat I'd have sued Private Banfield for plagiarism, but Mowat, he's all for live-and-let-love. I don't think that ought to apply to biologists, do you?

Terrible memory that Cadet Banfield has too. Can you imagine Marshal Mowat ordering a folding canoe? What he actually ordered was a twenty-five foot cabin cruiser with a built in bar – but try and get *that* one past the Tresurey Board! Folding canoe indeed!

Now *that's* a low one, that remark about poor Admiral Mowat's punctuation, style, and grammar in his wolf report. Call him a liar if you must – he can stand it – but to impugn (is that how you spell it?) his punctuation . . . Did Generalissimo Mowat ever suggest that Apprentice Banfield can't tell the difference between a gopher skull and a pickled cormorant? Not on your life, he didn't.

We wolves (whats left of us) have decuded to fight Banfield with fire. We've got our own little plan under way for human-control. Going to get some help from dogs too. We plan on planting mesquite buttons in the places where those fellows in Ottawa usually graze. Whats the idea of that? Well, you see, we sort of figured that it might help to free their imaginations a little bit; put a little colour in their lives you might say. Do you think they'd be happy if we did that? Because thats what we wolves want – is happy people. You see how superior our philosophy is to yours? Well thats enough. But you can tell MR. Banfield that MR. Mowat is some sorry about all those letters the Deputy Minister's been getting from all those people who don't mind wolves, and passing on down the line to Mr. Banfield. It *is* kind of a dirty trick, and I suppose I'd be sore about it too, if I was him.

UNCLE ALBERT.

Received and relayed through Daisy Mae, the Voice of Mowat's Instantaneous Wolf Translation Service, this fifth day of April.

F. M.

Editors note: This letter, although addressed to the editor, reached him by an indirect route. Bewildered readers should refer to a review of *Never Cry Wolf* in the Canadian Field-Naturalist 78 (1): 52-54. In deference to the writer the original grammar and spelling have been retained as nearly as possible. Unfortunately Uncle Albert's exact signature, a more-or-less careful paw mark, had to be omitted from the printed version as was a note in Farley Mowat's handwriting indicating some difficulty incurred in obtaining it.

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The eighty-sixth annual meeting of the Ottawa Field-Naturalists' Club was held on Tuesday, December 8, 1964, at 8:15 p.m. in the auditorium of the National Museum of Canada.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Members are reminded that the one hundred and thirty-first annual meeting of the American Association for the Advancement of Science will be held in Montreal, December 26-31, 1964. The Ottawa Field-Naturalists' Club is affiliated with the AAAS.

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The Canadian Field-Naturalist

Volume 78 OCTOBER-DECEMBER 1964 Number 4

ALBERT ANDREW WOOD
1885-1963

H. B. Wressell
Entomology Laboratory, Research Branch, Department of Agriculture
Chatham, Ontario

Al Wood was a naturalist of the old school – the school of W. E. Saunders and John Dearness. In these days of specialists, it was a privilege to know a man who was interested in so many aspects of nature study; one who could discuss them with such appreciation and intelligence.

A. A. Wood was born in London, Ontario, of pioneer stock, on May 2, 1885. Originally he had planned to be a doctor and in 1903 he took a pre-medical year at Washington College, Washington, D.C. But he found that he could not adapt himself to certain aspects of the course and entered the business of tailoring, after taking a course in New York City. For some sixteen years he pursued this work until 1922 when he was persuaded to join the staff of the Dominion Entomological Laboratory at Strathroy, Ontario. While there, Al began preparing entomological exhibits for local fairs. His natural aptitude for this work increased, and eventually he prepared exhibits for entomology laboratories across Canada and for the National Museum in Ottawa. He achieved his first great success in this line at the World's Grain Show, held in Regina in 1933. Al, in his dry way, enjoyed telling the story of the farmer who visited the exhibit several times on successive days. Finally the man asked why the wheat plants did not wilt in the hot atmosphere of the cage. Al always chuckled with pride when relating this; it was a tribute to the painstaking care he took when preparing the exhibit. In 1938 he was transferred to the Chatham laboratory and here he remained until he retired in 1955. He studied methods of preparation at many American and the larger Canadian museums and developed techniques for preparing displays of insect and disease injury in several media. Just before retirement he wrote a manual, "Preparing Insect Displays". This book shows the same careful work so characteristic of A. A. Wood. Besides the manual, Al published papers on a variety of topics, including ornithology, mammalogy, and entomology. He had a pleasant, lucid style of writing which was also informative.

Al was an ardent collector from boyhood, and received encouragement from men like J. A. Morden and W. E. Saunders, with whom he went on field trips. His bird and mammal skins are found in scientific study collections in many museums, both in Canada and the United States. The great Canadian bird artist, Allan Brooks, claimed that Al's study skins were among the best he had seen. Al often told about rising before dawn to go on a trip before his

Mailing date of this number: 31 December, 1964

day's work. He would describe the dawn chorus and the thrill of hearing a new song for the first time. That was how he located Kentucky and Blue-winged warblers – the first being the third Canadian record for the species at that time. He also had a very fine insect collection which was one reason he joined the Dominion service. Later he made a collection of flowering plants native to his area. It was characteristic of him to turn to a new hobby after retirement – the collection of lichens and mosses, where he found new Canadian species. To top it off, in later years he became an ardent star watcher, just as the space age began! Also, after retirement, he spent several summers as naturalist at a camp for young people conducted by the Seventh Day Adventists, to which group Al was a sincere and devoted member.

In 1925 Al married Gertrude Isobel Wilson of London, Ontario. Three daughters were born to them and a more devoted family group it would be hard to find.

THE BREEDING BIRDS OF MANDARTE ISLAND, BRITISH COLUMBIA*

R. DRENT, G. F. VAN TETS, F. TOMPA and K. VERMEER
Department of Zoology, University of British Columbia, Vancouver

INTRODUCTION

EVERY YEAR SOME 5500 INDIVIDUALS of six sea-bird species gather on Mandarte Island to breed, thus making it the largest and most varied colony on the inner south coast of British Columbia. Certain plants and the sea-fowl formed an important resource for the native people in bygone times, and Mandarte is still an Indian Reserve. At present, however, infrequent egg-collecting is the only right exercised by the owners.

In 1957 a permanent field camp was established on the island by the Department of Zoology, University of British Columbia (Vancouver), and students have lived there every season since (May 3-September 4, 1957; May 1-August 24, 1958; April 24-September 15, 1959; May 5-September 1, 1960; May 1-August 30, 1961; May 2-August 31, 1962). Goal of the work was to present theses on the following topics:

G. F. van Tets	1957-1959	Cormorant ethology
R. Drent	1959-1960	Pigeon Guillemot breeding biology
F. Tompa	1960-1962	Song Sparrow population study
K. Vermeer	1961-1962	Glaucous-winged Gull breeding biology.

Each season as much time as possible was devoted to gathering nesting data, the material being recorded on cards of the British Columbia Nest Records

*Contribution No. 4 from the B.C. Nest Records Scheme, Department of Zoology, University of British Columbia, Vancouver 8, British Columbia.

Scheme (*see* Myres *et al.*, 1957) and now on file at the Department of Zoology in Vancouver. In the scarcity of numerical material on the breeding of sea-birds in the Pacific Northwest, the data we have accumulated in the past six seasons warrant a general account of the island and its bird life. Following a brief description of vegetation, topography, climate, and a word on the mammals, the breeding birds will be treated. For each species distribution and numbers on the island, laying season, incubation and fledging periods, clutch size, and survival of eggs and young will be given. The questions we seek to answer are, what is the breeding season of the various sea-birds, how long does it take the pair to raise their young, what is their average production, and what are the principal causes of loss. With the Song Sparrow, resident on Mandarte, the approach has been rather different, and the account here concerns chiefly population census and territory size. Our intent is not to draw theoretical conclusions, but rather to record facts in order to stimulate further effort in gathering precise data on breeding biology.

Further activities on the island included banding. Banding totals for the breeding species are listed below.

TABLE 1. — Birds banded on Mandarte Island, 1957–62

Species	Banded as adult	Banded as nestling or local young
Double-crested Cormorant	0	909
Pelagic Cormorant	0	1325
Black Oystercatcher	0	4
Glaucous-winged Gull	77	7002
Pigeon Guillemot	65	178
Tufted Puffin	0	3
Northwestern Crow	0	60
Red-winged Blackbird	2	2
Song Sparrow	115	438

In addition, nestlings of various sea-birds were supplied to Dr. J. Koskimies (visiting from the University of Helsinki) for his 1959 thermoregulation work (not yet published), and to Dr. W. N. Holmes (Vancouver) for his work on the nasal gland (Holmes *et al.*, 1961). External parasites were collected where possible, and turned over to Prof. G. J. Spencer (Vancouver), who has reported one of the records (Spencer, 1960).

Published material concerning Mandarte is scant. W. B. Anderson lived on the island as warden during the 1915 season, and his brief report (Anderson, 1916) furnishes the earliest census of the birds. There are no published reports from wardens in later years. J. A. Munro of the Canadian Wildlife Service documented the status of the sea-birds on a number of visits from 1921 to 1937 (Munro, 1925, 1928, 1929, 1937), and in particular was responsible for recording the establishment of the Double-crested Cormorant as a breeding species. In later years the Victoria Natural History Society have several times recorded useful estimates of the birds in their bulletin. Sprot (1937) summarized results of Glaucous-winged Gull banding for the period 1929-34.

Work on this account has been shared by the authors as follows. G. F. van Tets supplied all data for the 1957 and 1958 seasons and the cormorant and gull data for 1959, whilst K. Vermeer supplied the gull data for 1961 and 1962. These data, and the nest record cards for all years for all species, were placed at the disposal of Drent who compiled the species accounts, with the exception of the Song Sparrow section, which was contributed by F. Tompa. The final form of the paper has been arrived at by mutual criticism.

ACKNOWLEDGMENTS

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Our work has been financed by a number of bodies, to whom we give grateful credit: Woodrow Wilson National Fellowship Foundation, National Research Council of Canada, Fisheries Research Board of Canada, and the Frank M. Chapman Memorial Fund.

Particular mention must be made of the help in the 1957 season of J. Takacs, and in the 1958 season of D. Kennedy, and we close with thanks to the Mathews of Randle's Landing, who have meant much to all of us working on Mandarte.

DESCRIPTION OF MANDARTE ISLAND

Location and topography

Mandarte, commonly called Bare or Ridge Island, lies among the Gulf Islands in Haro Strait, off the south end of Vancouver Island. Precisely, the location is 48° 38′ N, 123° 17′ W (*see* Figure 1). A small skerry, termed North Rock, lies 400 meters northwest of the island, and an islet, here called South Islet, some 165 meters to the southeast.

Mandarte Island itself is some 100 meters broad and 700 long, and runs SE-NW along the greater dimension. The island is formed by an escarpment of calcareous sandstone protruding from the sea. A low broken cliff some 3-4 meters high forms the northeast facing shore (Figure 16), and from this low side the land rises unevenly to the precipitous southwest facing shore, composed of steep cliffs ranging from 10 to 29 meters in height. Midway a groove scores the long axis of the island, and here the soil accumulation supports shrubbery and a few gnarled trees; elsewhere bare rock and scattered grass prevail. The low northeast shore is skirted by a broad wave-cut platform (Figures 2A, 11, 16), but the steep southwest shore shows only a slight nick at water level (Figure 3). The foreshore, then, is restricted to the northeast

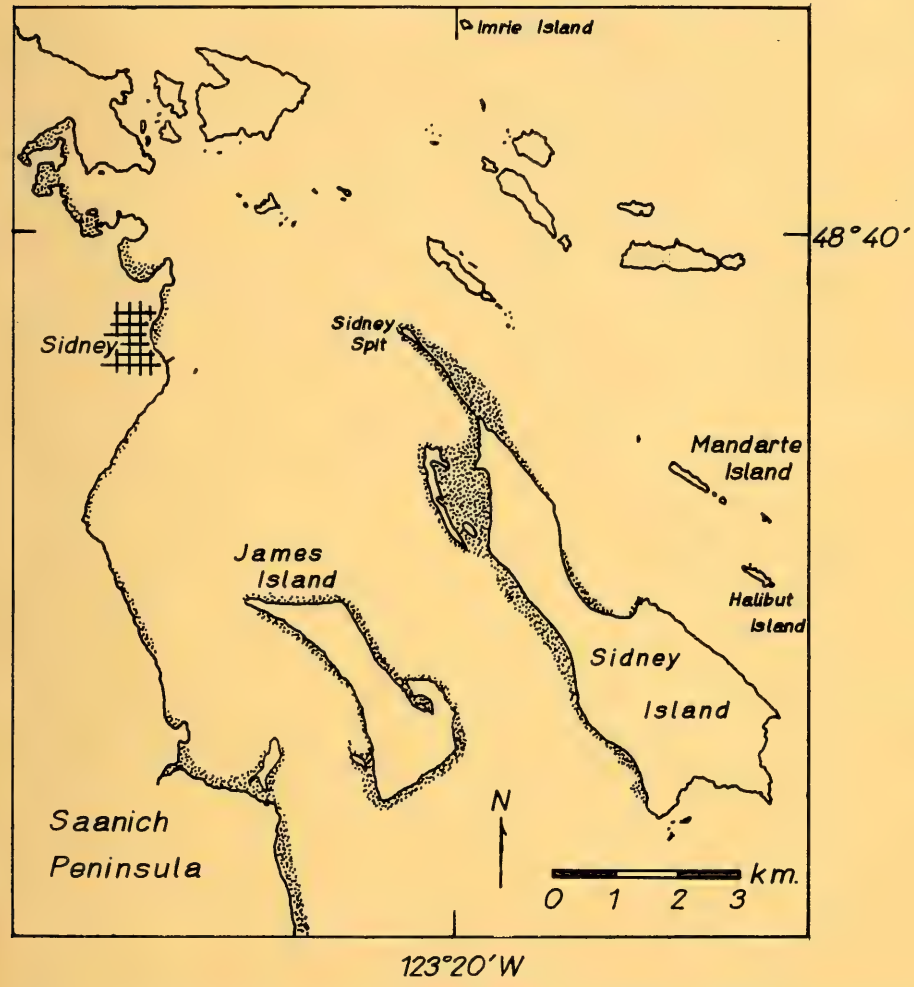

FIGURE 1. Map of east portion of Haro Strait showing localities mentioned in the text. Shallows are indicated by stippling.

side and is largely formed by an eroded rock shelf, with a few small pockets of coarse shell fragments. Beach debris is virtually absent.

Vegetation

Exclusive of cliffside, shrubbery and trees make up some 30 per cent, bare rock and grassy areas some 70 per cent, of the 5 hectare surface area of Mandarte (*see* Figure 2). Near the north end a conspicuous clump of trees breaks the skyline (Figure 21), the living members being five Douglas Fir (*Pseudotsuga menziesii*), three Grand Fir (*Abies grandis*), several Arbutus (*Arbutus menziesii*), and a luxurient growth of Willow (*Salix* spp.). Ocean Spray (*Holodiscus discolor*) forms a dense undergrowth. Age and height

were measured for some of these trees: the Douglas Fir ranged from 60 to an estimated 200-300 years old, whilst the range in height was 18-21 meters. The Grand Fir were 100-110 years old, and the largest reached 24 meters, whilst an averaged-sized Arbutus was 90 years old and 19 meters high. These measurements have implications for the vegetation history of the island.

Elsewhere on the island the tongues of deeper soil support a mixed shrubbery mostly less than 2 meters high. The chief components are Waxberry (*Symphoricarpus alba*), Wild Rose (*Rosa* sp.), Ocean Spray (*Holodiscus discolor*) Wild Blackberry (*Rubus macropetalus*) and Fireweed (*Epilobium angustifolium*), in that order of abundance. A scattering of Saskatoon Berry (*Amelanchier florida*) and to a lesser extent Bitter Cherry (*Prunus emarginata*) protrude above the shrub, and at the south end a clump of Garry Oak (*Quercus garryana*) exists. The oaks hardly exceed 5 meters in height from the ground, though one large specimen was 125 years old. In addition, two stunted Crab Apple (*Malus fusca*) and several Choke Cherry (*Prunus virginiana*) survive along the island crest. The rocky open areas remain to be treated. The dominant plant is Broma Grass (*Bromus carinatus*), and Camas (*Camassia quamash*) is abundant. The conspicuous members of the vegetation have been listed, and a more detailed treatment will not be attempted here.

There is no reason to believe that the vegetation on the island has changed much in recent years. The present pattern of shrub and open areas depends on soil depth (one thinks especially of water-holding capacity), not on the activities of the nesting birds or some catastrophe such as fire (cp. tree ages). This relative stability is made clear by a comparison of two photographs of the island taken in 1915 (Anderson, 1916), when the sea-bird colony was less than one-sixth its present size, with photographs taken in 1960. Conditions prove to be practically identical. One change can, however, be traced to the birds: the larger Douglas Fir and the plants directly beneath them are gradually dying due to the accumulation of guano from the Double-crested Cormorants and Glaucous-winged Gulls that perch on these trees.

Climate

Kendrew and Kerr (1955) have characterized the climate of the British Columbia littoral as having a small annual range of temperature and mild humid winters, most of the precipitation falling in this season and decreasing after March, and with warm though not hot summers, July and August forming the dry season. Mandarte, leeward of the high mountains of Vancouver Island, lies in a zone of low precipitation (less than 40 inches annually) compared to other parts of the coast, a zone that has been distinguished as the Gulf Islands Biotic Area by Munro and Cowan (1947), chiefly on the basis of botanical features dependent on the aridity.

The closest station to Mandarte where weather records have been taken over a long period is the Saanichton Experimental Farm, situated on the Saanichton Peninsula at 48° 37′ N, 123° 25′ W, some 9.5 kilometers west of the island. Table 2 gives the 48-year averages of this station for temperature and precipitation over the months April-September, embracing the breeding seasons of the various sea-birds on Mandarte.

TABLE 2. — Weather Records from Saanichton Experimental Farm

Month	Temperature (°F.)		Precipitation (inches)
	Mean	Mean extremes	
April	47°	40–55°	1.6
May	54°	45–62°	1.1
June	58°	50–67°	1.1
July	62°	53–72°	0.7
August	62°	53–71°	0.8
September	57°	49–64°	1.4

It will be seen that the period is one of moderate temperature and little rain — only about 22 per cent of the annual precipitation falls in these six months.

THE MAMMALS

Only three terrestrial mammals are known from Mandarte, and others (bats, seals, whales) will not be listed here. 1. *Oryctolagus cuniculus* — released on the island long ago (Carl and Guiguet 1958: 11, prior to 1915, *see* Anderson 1916) the European Rabbit has recently died out on Mandarte (last report 1955-56, none seen from 1957 on). 2. *Peromyscus maniculatus* — the Deer Mouse is the only mammal at present resident on Mandarte, and is commonly seen about the island. 3. *Mustela vison* — although numerous on surrounding islands, the Mink has been seen on Mandarte only once (December 1960) and has to our knowledge never been present during the breeding season.

THE BREEDING BIRDS

Regular Breeders

1. *Phalacrocorax auritus* — Double-crested Cormorant
2. *Phalacrocorax pelagicus* — Pelagic Cormorant
3. *Haematopus bachmani* — Black Oystercatcher
4. *Larus glaucescens* — Glaucous-winged Gull
5. *Cepphus columba* — Pigeon Guillemot
6. *Lunda cirrhata* — Tufted Puffin
7. *Hirundo rustica* — Barn Swallow
8. *Corvus caurinus* — Northwestern Crow
9. *Agelaius phoeniceus* — Red-winged Blackbird
10. *Melospiza melodia* — Song Sparrow

Species of changing or uncertain status

Phalacrocorax penicillatus, Brandt's Cormorant: expected future breeder
Ardea herodias, Great Blue Heron: past breeder
Selasphorus rufus, Rufous Hummingbird: possible breeder

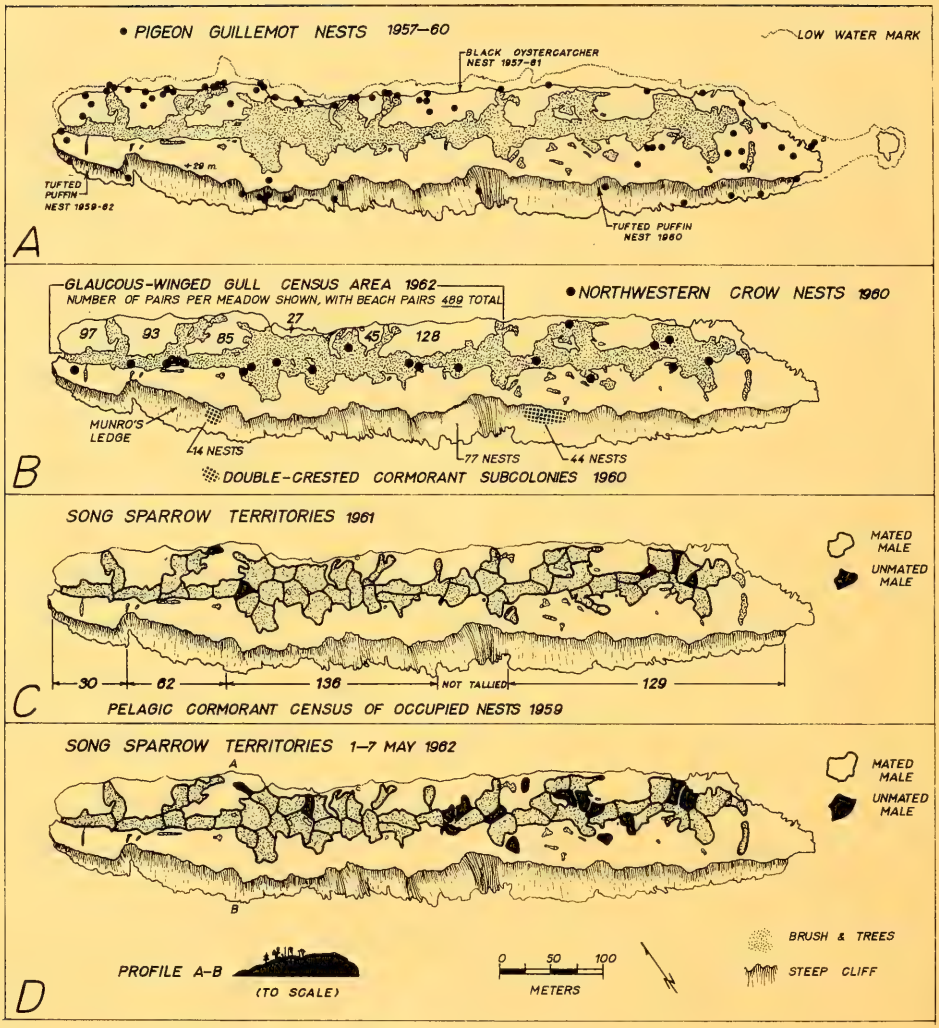

FIGURE 2. Map of Mandarte Island showing distribution of nesting birds.

Notes on use of names

Double-crested Cormorant and Glaucous-winged Gull are unwieldy common names, so we have generally used "Double-crest" and "Glaucous-wing" in the species accounts. Latin nomenclature follows the 1957 A.O.U. check-list, though there are arguments for ranking the Pigeon Guillemot as *Cepphus grylle columba*, and Johnston (1961) has recently urged again relegating the Northwestern Crow to the subspecies level (*Corvus brachyrhynchos caurinus*).

FIGURE 3. Cliff along southwest shore of Mandarte Island with nesting Double-crested Cormorants at B, nesting Pelagic Cormorants elsewhere. At A Munro's Ledge, site of the original Doublecrest colony.

1. *Phalacrocorax auritus*, DOUBLE-CRESTED CORMORANT

Census and distribution

The Double-crested Cormorant began nesting on the inner coasts of southern British Columbia and northern Washington about 40 years ago (Drent and Guiguet, 1961). Of the British Columbia colonies, Mandarte was the first to be discovered, thanks to the vigilance of W. Burton and the prompt verification by J. A. Munro (Munro, 1928). Later the colony on Ballingall was found, but judged older in origin (Munro, 1937). Mandarte was thus the second colony to be established in the Province, but it is today by far the largest. Available counts for the Mandarte colony are given below; a more detailed listing with references will be found in Drent and Guiguet (1961: 25-26).

1927	1-3 pair, the first report
1935	5 pair
1936	9-11 pair
1942	15-20 pair
1945	23 pair in original group, total not certain
1953	145 pair total, three subcolonies (25, 55, 65)
1957-60	135-150 pair, in three subcolonies (see text)

It is of interest to trace the spread of the Double-crest colony over the island. Munro's (1937) photograph of a group of nests in 1936 shows a ledge we have been able to locate precisely (Figures 2B and 3). The original 1927 nest was found in the near vicinity, and all the nests were located here until 1942. The area continued to be used until at least 1945, but sometime before 1957 (probably before 1953) the original ledge area was abandoned. At present the Double-crests are distributed over the southwest cliffs in three subcolonies, the minimum number of occupied nests in 1960 being 14, 77, and 44 from north to south (Figure 2B). Further details are lacking.

It is evident that the first site occupied by Double-crests at Mandarte was not the most favourable cliff formation available, but rather represented the closest possible Double-crest terrain to the nesting Pelagic Cormorants, restricted to the north cliffs at that time.

Nesting habitat

Birds of all ages perch in the clump of Douglas Fir on the island, and court in them, but unlike the case at the nearby Channel Island and Ballingall colonies (approximately 20 kilometers distant) the Double-crest has never nested in trees at Mandarte. Rather it here builds its nest flat on the rock, choosing rounded shoulders and broad ledges along the cliffside, in contrast to the Pelagic Cormorant which prefers more precipitous terrain.

Methods for gathering nesting data

A limitation when working with the cormorants was the constant threat of crow and gull predation. If put off the nest, the cormorants were liable to lose eggs and small young in short order. Observation on the Double-crest was therefore confined to checking the nests daily by telescope from a nearby blind, the contents being ascertained at nest relief or when the sitting bird rose to shift the eggs, etc. A further difficulty arose in following the fate of the young. Banding at the nest was carried out when the chicks were three to four weeks old, and displacement of some of the older chicks to strange nests was unavoidable.

Laying season

Progress of clutch commencement in 1959, the only season with complete data, is shown in Figure 4. The Double-crest is the first of the sea-birds on Mandarte to commence laying, the first eggs appearing in the latter part of April. Early layings are lost almost without exception, however, to predating gulls and crows. Most clutches are started in May, though replacements may be found up to the middle of July. In favourable years a second period of laying occurs in early August, and by observation of banded birds in 1959 it was established that some of these birds had laid previously in the same season. At least one pair laid a clutch of three after the first brood successfully fledged. Young were raised from the August layings, so in British Columbia the Double-crest is, potentially at least, double-brooded. The closely related European Cormorant is likely also occasionally double-brooded. Kortlandt (1942) gives six records of the raising of two broods in the same nest in the same season for *Phalacrocorax carbo* in the Netherlands. He states that in one case the same

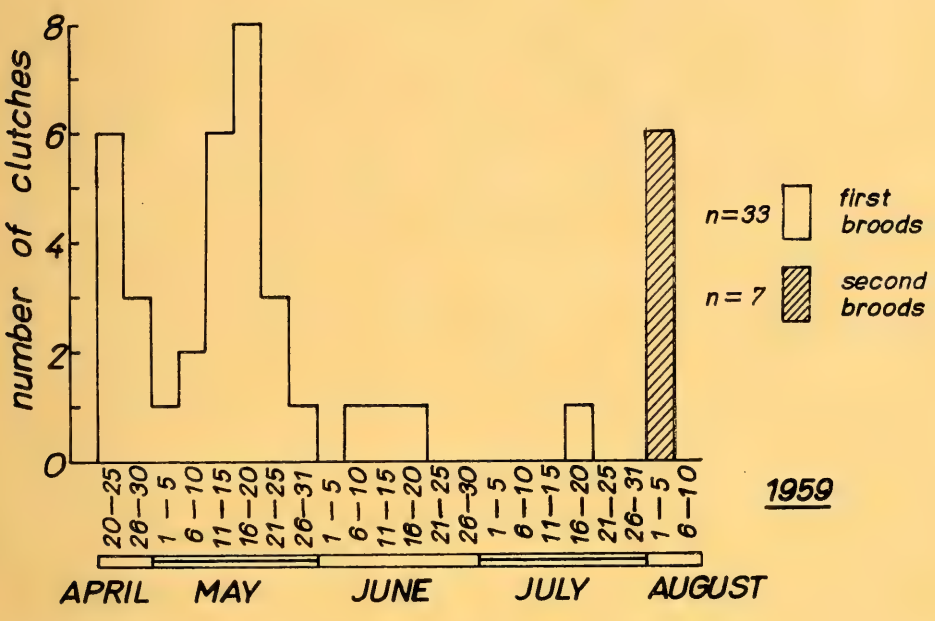

FIGURE 4. Clutch commencement of the Double-crested Cormorant on Mandarte Island.

parents were most probably involved, in another they were different, and in the remaining four identity was unknown.

Clutch size and egg replacement

Loss of eggs through predation is so common that representative frequencies for clutch size were not obtained, but it can be said that clutches of four predominate, those of three are common, and the maximum recorded in the study period was five.

Loss of the entire nest contents (eggs or young) commonly results in a replacement clutch (i.e. repeat laying). In 12 first replacements (1959 and 1960) 3 of five, 4 of four, 4 of three, and 1 of two eggs, the average interval from last loss to commencement of the replacement clutch was 13 days (7-8, 8-9, 9, 11-12, 11-13, 11-13, 13-15, 14-15, 14-16, 15-16, 16-17, 19-21 days, with the accuracy indicated). There were two records where loss of the replacement in turn led to further repeat clutches (loss of repeat clutch of four followed in not less than 17 days by first of two eggs of third set; in the other case loss of repeat clutch of two followed in 6-11 days by one egg, loss in turn and followed by first of two eggs of the fourth set in 10-11 days). The maximum number of eggs laid in any one nest in any one of the three seasons 1958,

1959 and 1960 was 11 eggs. Replacement clutches in *Phalacrocorax aristotelis* are discussed by Snow (1960) who records an interval of 21 and one of 22 days between loss of the original and commencement of the repeat clutch.

Incubation period

Incubation commences with the first egg, though the birds do not sit closely at first. Laying-hatching intervals for 55 eggs are assembled in Table 3. Laying and hatching were each known to the nearest day, assuming that the eggs hatched in the order laid.

TABLE 3. — Laying-hatching intervals in Double-crested Cormorant. Position in clutch indicated.

	A	B	C	D	E
25 days			1		
26 days			3		
27 days		5	2	2	
28 days	1	6	4	1	
29 days	5	6	4		
30 days	4	1	1		1
31 days	4		1	1	
32 days	1				
33 days		1			
Total eggs	15	19	16	4	1
Mean (days)	29.9	28.4	27.9		

The material for the first three eggs in the clutch is large enough to allow a comparison, and leads to the conclusion that incubation becomes fully effective with the second egg, or shortly thereafter. (Throughout this paper position in the clutch is indicated by calling the eggs A, B, C, etc., in the order laid.) B eggs in 3-clutches hatched in the same interval as those in 4-clutches (5 and 10 records respectively), so our material does not indicate that the onset of effective incubation is delayed in the larger clutch. The incubation period for the Double-crest can therefore be considered as 28 days (mean of 40 eggs, from second to fifth in the clutch, with a range of 25-33 days). Kendeigh (1952:182) quotes Mendall and Lewis that incubation in this species lasts 24-25 days, but without definitions this figure cannot be compared with ours.

Fledging period

Precise data are lacking, but the following outline can be offered: after the third week short excursions beyond the nest rim are undertaken, and visits are paid to other nests at the close of the fourth and beginning of the fifth weeks. In the fifth-sixth weeks short flights about the colony are attempted. During the sixth-seventh weeks, when the juvenal plumage is almost complete, the chicks start to bathe and swim by their own choice, and gradually leave the colony to take up an independent life.

For the related *Phalacrocorax carbo*, studied at tree-nesting colonies, Kortlandt (1942) states that the young fly out at seven weeks and become independent at 12-13 weeks of age.

Survival of eggs and young

TABLE 4. — Survival of eggs and young in Double-crested Cormorant

Year	nests total	eggs total	chicks				young fledged		
			per nest	total	% eggs	per nest	total	% chicks	per nest
1958	34	126	3.7	85	67%	2.5	80	94%	2.4
1959	32	147	4.6	80	54%	2.5	77	96%	2.4
Both	66	273	4.1	165	60%	2.5	157	95%	2.4

TABLE 5. — Causes of egg failure, Double-crested Cormorant

	Predated	Addled
1958	11 eggs, 9% eggs laid	30 eggs, 24% eggs laid
1959	41 eggs, 28% eggs laid	26 eggs, 18% eggs laid

Hatching success was 60 per cent in 1958-59, the balance of the eggs laid being either lost through predation, or failing to hatch. The latter are grouped as "addled eggs", and owe their failure to infertility or embryonic death. Addled eggs made up 56 of the total 273 eggs laid in both seasons, i.e., 21 per cent. This compares with 201 out of 921, i.e., 22 per cent, in *Phalacrocorax aristotelis* (Snow, 1960, calculated from her Table 8).

Loss from hatching to nest departure is low — in 1958 and 59 only 5 per cent of the chicks were lost — so that on Mandarte Island the most important single factor influencing fledging rate in the study period was egg predation. Egg predation is principally accounted for by the Northwestern Crow, which nests on the island and constantly patrols the cormorant colonies to scavenge for fish scraps. These crows are always ready to seize eggs and small young when this opportunity arises. As an example of their destructive capacity, consider a 45-minute banding operation among about 120 nests of the Double-crest (July 8, 1960), when crows were quick to take advantage of the temporary absence of adults from the nest as the two banders moved along the cliff. An observer kept close watch meanwhile and observed 25 eggs and eight newly hatched young carried off by crows; loss by gulls was nil. The principal opportunities offered the crows in natural circumstances are the moments of nest relief (*see* Drent and Guiguet 1961: Figure 55) and colony panics. Most 'natural' egg loss in the Double-crest probably occurs in the panics caused by the Bald Eagle. The Bald Eagle is a common nesting bird in

the area, and its frequent flights over the island may reflect only the use of updraughts from the cliffs to ease flight. We have never observed eagles to take birds at Mandarte. In any case, a direct flight over the cliffs puts the cormorants and gulls into the air at once, and crows (also gulls, but to a lesser extent) raid the unguarded nests. Bald Eagles inflict the most damage in this indirect way early in the season, when the cormorants are easily frightened. As time goes by the cormorants become less susceptible to disturbance, and moreover the frequency of eagle visitation declines. In the 1959 season the number of days on which eagles caused panics was 13 for May, 6 for June, and 2 for July; in 1960 the figures were 12, 7 and 4. The decline in visitation presumably reflects the shift of the eagles to the rivers when the salmon run begins.

The Double-crest is adapted to withstand considerable egg predation, as could be deduced from its increase on the B. C. coast in the face of constant presence of the Northwestern Crow. Comparison of the 1958 and 1959 figures demonstrates that the trebled egg predation in the latter season (reaching some 30 per cent of all eggs laid) was compensated for by replacement laying, such that the number of young fledged per nest remained constant. In 1960 (sample of 25 nests, followed by F. Tompa) egg predation again increased, but this time exceeded the ability of the cormorants to make good their loss by heightened laying. Predation eliminated some 60 per cent of all eggs laid (72 of 119), yet the number laid per nest was scarcely higher than in the previous season – 4.8 versus 4.6 respectively. These figures suggest that replacement laying was already maximum in 1959, such that egg predation in excess of 30 per cent surpasses the safety margin and will cause a decline in the number of young hatched per nest, and thus a decline in fledging rate.

Visitors to the island are a threat to cormorants in the egg stage, as the adults are invariably put off the nest, exposing the contents to the crows. When present on the island we were able to prevent such episodes, and it is significant that of the 48 eggs lost through predation in the 1960 sample, 29, i.e., 60 per cent, disappeared whilst we were absent on our weekly supply trips. We suspect that incautious visitors were responsible for the excessive egg mortality in that season.

Comparable figures on egg and chick survival from the literature on cormorants are those of Kortlandt (1942) for *Phalacrocorax carbo* in the Netherlands and those of Snow (1960) on *P. aristotelis* at Lundy. Kortlandt supplies figures for the number of young reaching flying age in high tree nests at Lekkerkerk in five seasons. In total, 211 young were raised in 119 nests for a mean of 1.8, but Kortlandt thinks that the Dutch average normally lies at about 1.25. Egg laying and hatching success were not treated.

Snow's data on the Shag extend over four seasons (294 nests in all). Hatching success varied from 60 to 73 per cent, fledging success from 67 to 95 per cent, normally lying at about 90 per cent and the mean number of fledged young per nest ranged from 1.3 to 2.3. Hatching and fledging success are thus closely similar to the Double-crest on Mandarte in the 1958 and 1959

seasons, but as the Double-crest has a larger clutch on the average, the pair raises more young per season.

2. *Phalacrocorax pelagicus*, PELAGIC CORMORANT

Census and distribution

There are only five accurate estimates, based on nest counts, available for the Mandarte colony (see Drent and Guiguet 1961:40).

1915	25 pair
1936	164 occupied nests
1958	339 nests tallied
1959	357 nests tallied, total 370-380

Originally this species was restricted to the highest (and steepest) portion of the cliffside at the north end of the island, but it now nests throughout the length of the southwest side, as indicated in Figure 2C. The increase of the Pelagic Cormorant at Mandarte is part of a general increase in southern British Columbia (Drent and Guiguet 1961:120). When the study began in 1957 a group of about 40 pairs nested on South Islet, but this site was heavily disturbed and no cormorants have nested there since.

Nesting habitat

The Pelagic Cormorant nests on narrow ledges and brackets on the more precipitous portions of the cliff. At several points the recesses and crannies utilized suggest miniature caves, where the young are raised in partial obscurity. The distinction in nesting requirements between Double-crest and Pelagic is illustrated in Figure 3.

Methods for gathering nesting data

The remarks under Double-crest apply here also. In 1957 the South Islet subcolony was visited by night almost daily, when the 37 nests could be checked without risk of predation. The resulting disturbance was severe, however, so in later seasons observations were limited to telescope work from permanent blinds. The nesting habitat of this species at Mandarte limits such work, though, so the data are less extensive than those for the Double-crest.

Laying season

Laying commences in the end of May (May 16, 1957; May 27, 1959) and most first clutches are started before the middle of June, as shown in Figure 5 for the 1957, 58, and 59 seasons. Replacement clutches may occur through an additional one and one-half months (fresh August 4, 1958). At Race Rocks, B.C., (48° 18′ N, 123° 32′ W) in 1958 G. C. Odlum (BCNRS) noted the first eggs on May 26, and recorded 14 of the total 27 clutches as being started in the second week of June.

Clutch size and egg replacement

Modal clutch size for 56 clutches in the fourth week of June (1957 and 1958) was four, and the maximum six. If the entire clutch is lost a replacement clutch may appear, as in the Double-crest and the Shag (Snow, 1960). Of 28

nests of the Pelagic Cormorant where the original clutch was lost, the following number of eggs appeared:

0 eggs	10 nests
1 egg	13 nests
2 eggs	4 nests
3 eggs	1 nest

The maximum number of eggs laid in any one nest in the course of the season was seven, i.e., there are no records of more than one replacement clutch appearing.

Incubation period

Incubation periods of marked eggs were determined in 1957, and there are 21 records where the events of laying and hatching (i.e. young free of shell) are each known to the nearest day.

TABLE 6. — Laying-hatching intervals in Pelagic Cormorant Position in clutch indicated

	A	B	C	D
28 days		1		
29 days				2
30 days		1	2	1
31 days		6	2	
32 days	1	3	1	1

Mean for the 20 B, C, and D eggs is 30.7 days, and assuming that incubation becomes effective with the laying of the second or third egg as in the Double-crest, 31 days can serve as a provisional figure for the incubation period in the Pelagic Cormorant. No critical figures are known to us from the literature. For comparison, the following figures for *Phalacrocorax aristotelis* (Snow, 1960) may be cited. Seven eggs second or third in the clutch hatched in 30 or 31 days, and eight eggs first in the clutch in 32-35 days.

Fledging period

The chicks in some nests could be followed through to the close of the season, as owing to the nesting habitat banding did not cause such a severe shuffling of young as in the Double-crest. Age at nest departure was accurately ascertained for seven young in six different nests (1957, 1958, 1959) as follows: 42, 44, 48, 48, 49-51, 50-52, 50-51 days of age. The data are few as most of the chicks of known age had not left the nest at the close of observation. The maximum recorded for a young still in the nest was 58 days. Thus the only conclusion to be drawn from our figures is that nest departure begins at 40-50 days of age. Swartz and Cox (*in press*) report one fledgling Pelagic Cormorant leaving the nest at 53-56 days, another at 56-60 days of age. At what age the young finally become independent was not determined. For comparison Snow (1960) found *Phalacrocorax aristotelis* young to leave the nest at 48-58 days of age, with a mean of 53 days for 35 observations.

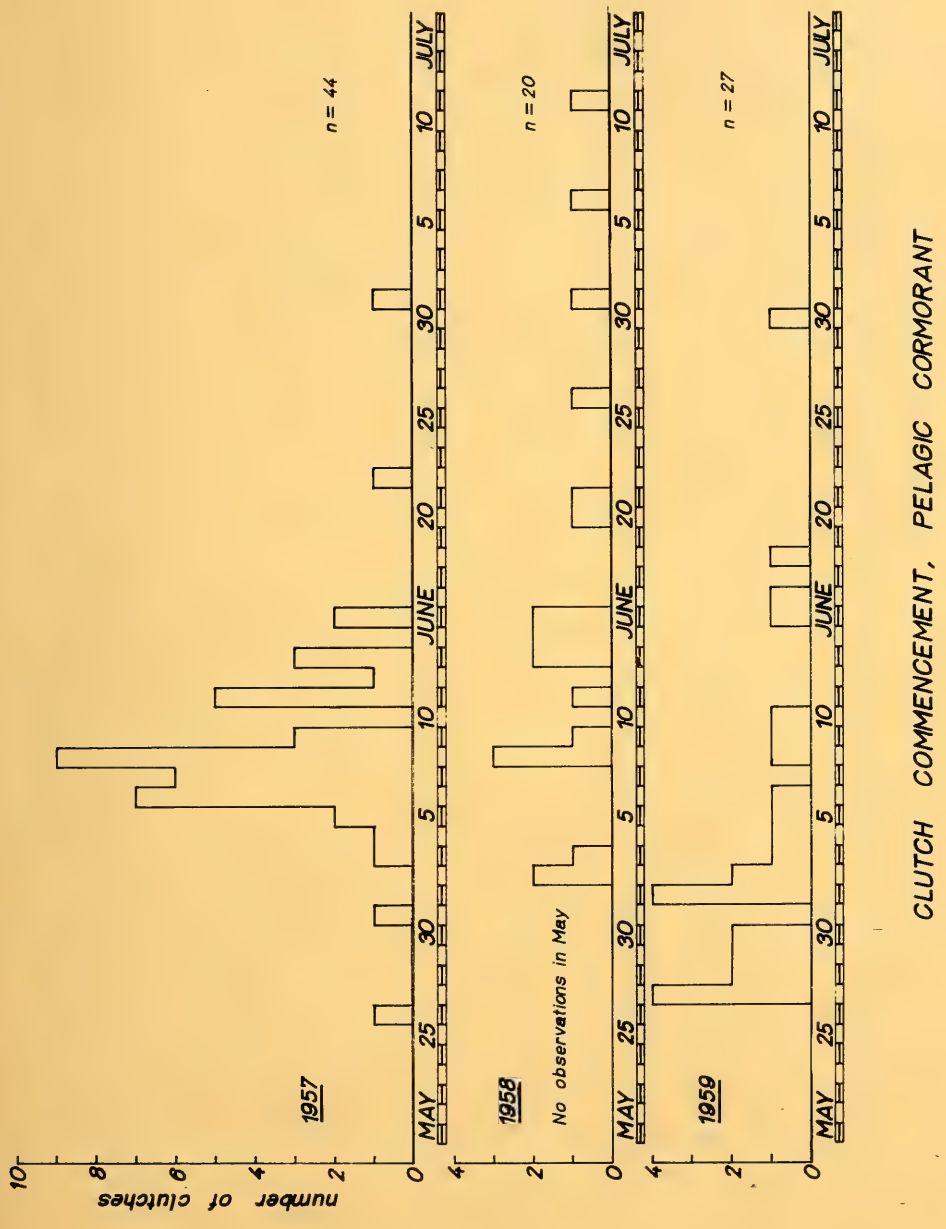

FIGURE 5. Clutch commencement of the Pelagic Cormorant on Mandarte Island.

Survival of eggs and young

TABLE 7. — Survival of eggs and young in the Pelagic Cormorant

Year	nests total	eggs total	per nest	chicks			young fledged		
				total	% eggs	per nest	total	% chicks	per nest
1957	37	141	3.8	70	50%	1.9	—	—	—
1958	17	—	—	43	—	2.5	34	79%	2.0
1959	22	—	—	58	—	2.6	43	74%	2.0

The 1957 data stem from the South Islet sub-colony visited by night, where loss of young after hatching was unusually heavy and hence is not entered here. For this season the causes of egg failure can be broken down as follows:

45 eggs predated, 32% eggs laid
26 eggs addled, 18% eggs laid

The 1958 and 1959 data derive from nests observed by telescope from the north blind, and though the fate of the eggs could not be followed satisfactorily, figures from hatching onwards were obtained.

The rather small material shows no striking difference from the Double-crest, but it does seem that the Pelagic is unable to lay as many eggs under similar predation pressure. The Pelagic Cormorant produces about the same number of young fledged per nest as the Shag (Snow, 1960: figures cited under Double-crest) though it starts with a larger clutch, the higher predation at Mandarte eliminating the difference.

3. *Haematopus bachmani*, BLACK OYSTERCATCHER

Census and distribution

A photograph of a nest with eggs taken in May 1896 by Dawson (Dawson and Bowles, 1909) furnishes the earliest breeding evidence for Mandarte. Eggs in the Provincial Museum collections were taken June 24, 1908 and June 10 and 16, 1910. Thereafter records are scant, and the oystercatcher was apparently absent from the island for a number of years. Anderson (1916), warden on the island in 1915, wrote "the rare Black or Bachman's Oystercatcher, in former years plentiful, has disappeared". Munro makes no mention of oystercatchers in the accounts of his visits in 1921, 1923, 1927, and 1936 (Munro, 1925, 1929, 1937). The first positive record after 1910 was furnished by Mr. A. L. Meugens of New Westminster, who photographed a nest with 2 eggs May 25 and 27, 1945.

In our period on the island, two pair have nested every season, one on the northeast shore north of camp (1957-1961) the other on South Islet 1957-1959, and the south end of Mandarte 1960-1961. The adults were not banded, so it is not known if the same individuals were involved each season. Other nesting sites of the Black Oystercatcher in the area are Imrie Island (eggs 1958, 1959,

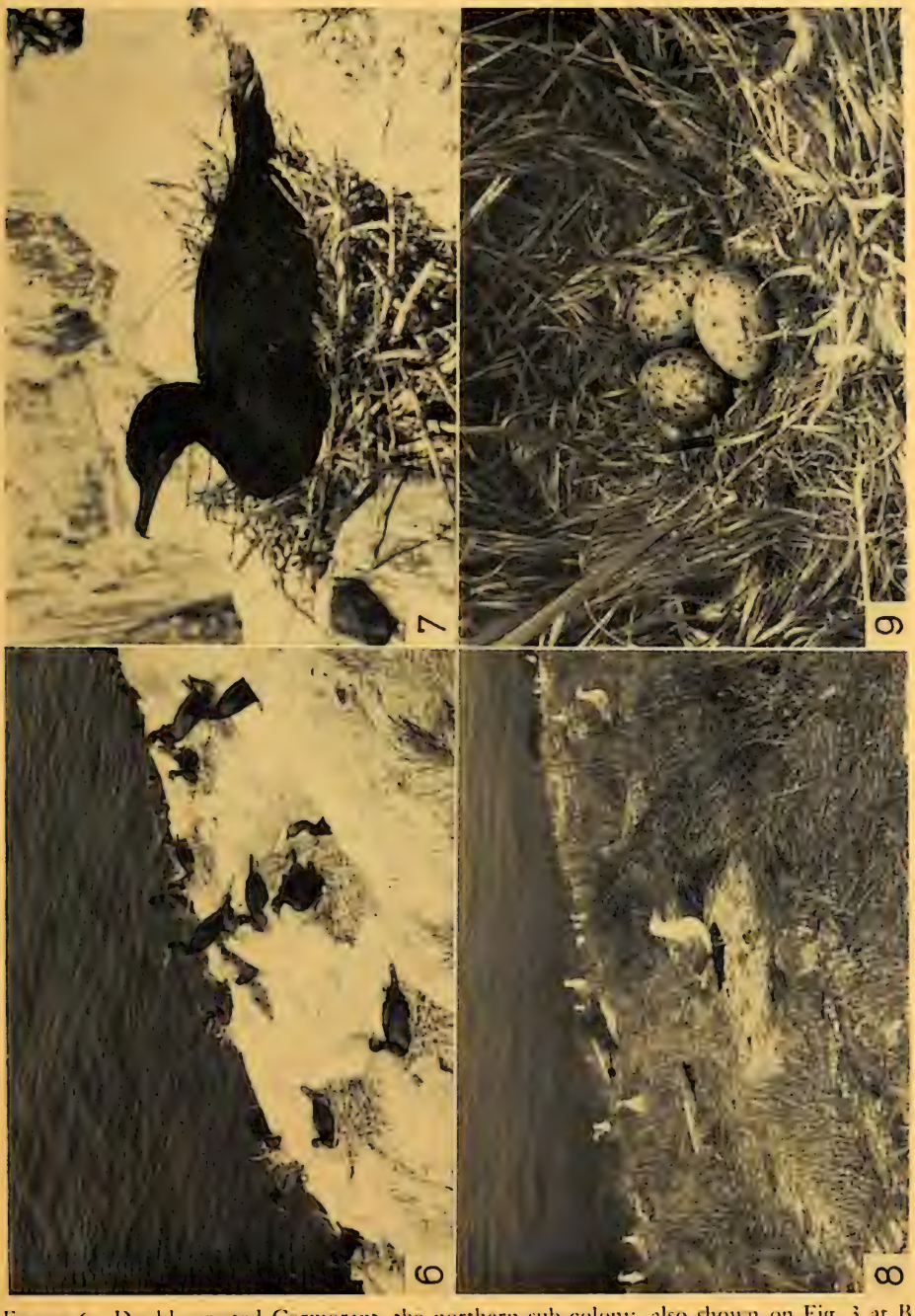

FIGURE 6. Double-crested Cormorant, the northern sub-colony, also shown on Fig. 3 at B.
FIGURE 7. Incubating Double-crested Cormorant, note bulky stick nest.
FIGURE 8. Typical Glaucous-winged Gull nesting habitat at Mandarte Island: an open grassy slope.
FIGURE 9. Nest of the Glaucous-winged Gull with full clutch of three.

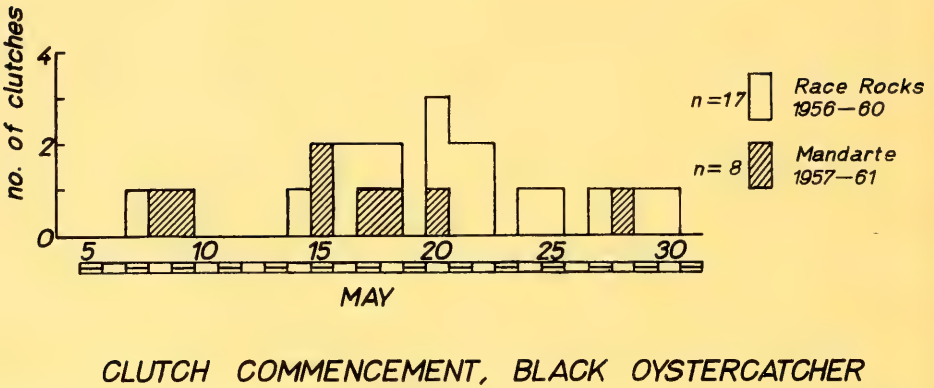

FIGURE 10. Clutch commencement of the Black Oystercatcher on the south coast of British Columbia.

1960, pair present 1961, chick 1962) and Halibut Island (eggs 1960 and 1961, not observed on that island previously). Observations at all these sites are included here.

Nesting habitat

Eggs were laid in nest-bowls lined with flattened stone chips, shells, barnacle fragments, etc., in three situations: (1) gravelly beach, (2) bracket in rock of beach cliff, (3) earth depression at brow of cliff. None of the sites were far from high water mark. The first type (Figure 14) was that used by the birds on Halibut, Imrie, and the south end of Mandarte, where the eggs were surprisingly difficult to locate against the pale substrate, predominantly crushed barnacles. As for the second type, the camp pair on Mandarte used the same two rock brackets (Figure 11), 2 meters above high water mark and within 6 meters of each other, in the four seasons 1958-1961 when eggs were found. If the first clutch was destroyed renesting occured in the alternate site. Faithfulness to the nest-site is a documented feature of *Haematopus ostralegus* (Jungfer, 1954), so that the conservatism of the Mandarte birds is easily explicable by assuming that the same individuals were involved. The third type, the earth depression site, was recorded once for a replacement clutch on South Islet (1958). The three sites in our area correspond to Dawson's descriptions for the species (*see* Webster 1941) with the exception that we have not seen the grass or dried moss type he mentions.

Methods of gathering nesting data

Our material is scant, as only the camp pair could be regularly watched (daily checks 1958, 1959, 1960). Some data are available from South Islet, Imrie, and Halibut, but this section could not have been attempted without the painstaking observations of G. C. Odlum, Lightkeeper at Great Race Rock (48° 18′ N, 123° 32′ W) who contributed data on four to six nests annually 1956-1960 for a total of 25 nests (BCNRS files). Incubation periods determined by W. Milne, Lightkeeper at Ivory Island, have also been included.

Laying season

Figure 10 shows dates of commencement of 25 first clutches, eight on Mandarte 1956-61, 17 on Race Rocks 1956-1960. It will be seen that laying extends through May, with a peak in the third week. Dates for five known replacement clutches were June 18, 1960 (Race Rocks); two on about June 10, 1958; one June 15, 1959; and one between July 4 and 5, 1959; the latter four on Mandarte. For the Sitka region of Southeastern Alaska Webster (1941) recorded a full clutch (4 eggs) on May 9, and a hatching egg August 6 or 7, as extremes in his 1940 study, indicating a spread of dates similar to our area.

Clutch size and egg replacement

The available figures for first clutches at Race Rocks, Mandarte, Halibut, and Imrie, 1956-1961, are listed below.

TABLE 8. — Clutch size of the Black Oystercatcher, British Columbia south coast.

	Race Rocks	Elsewhere	Total
Three eggs	12	5	17
Two eggs	7	3	10
One egg	1		1

The 28 clutches give a mean of 2.6. Webster (1941) reported a mean of 2.7 for the Sitka area, based on 13 first clutches in 1940: 5 of two, 7 of three, and 1 of four eggs.

The Black Oystercatcher reacts to total clutch destruction by laying a replacement clutch; five cases, 2 of two eggs, 3 of one, are available in our records. In one case the interval from loss to commencement of the replacement clutch was 15-18 days, in another 9-17. Of special interest is the Mandarte camp nest in 1959. The original clutch of three was gradually lost to crow predation, the last egg disappearing between June 1 and 3. On June 15 the first egg, and on June 17 the second, of the replacement clutch appeared, the interval thus being 12-14 days. This set was lost in turn June 24-27, and on July 4 or 5 the single egg of the third set was laid, (thus after a 7-11 day interval), hatching successfully on July 30.

Webster (1941) reported clutch size of three second sets as 2 of two eggs and 1 of one.

Incubation period

Table 9. — Laying-hatching intervals (days) in Black Oystercatcher

Egg	Clutches of two	Clutches of three
A	26, 28, 29, 29, 30, 32	27–28, 28, 30
B	25–26, 26, 26, 27, 27	25–26, 27, 28, 28
C	—	25–26, 26, 27, 27

Table 9 assembles the data on 22 eggs from the various British Columbia sites mentioned. Incubation period of the Black Oystercatcher (i.e. the interval from laying of last egg of the clutch until the chick from that egg is free from the shell) can be stated as 26-27 days, with the possibility that it is sometimes as short as 25 days. More data are needed to bear out the suspicion that effective incubation commences somewhat later in 3-clutches than in 2-clutches (note the 28 day periods for B eggs in the former).

Webster (1941) gave four observations of incubation period as follows: 27, not over 26, 26-27, and 27-30 days. These were calculated from laying of the last egg (Webster, *in litt.* July 12, 1961) and thus comparable to our figure of 26-27 days.

Fledging and departure from nesting islet

Scattered observations were made on banded young of known age on Mandarte. One individual could fly strongly by 47 days of age, but the true fledging period is doubtless shorter than this. Webster (1942) indicates that fledging takes place shortly after five weeks of age.

The young we observed remained with their parents on Mandarte to the close of observation. Last dates of sighting follow: two families in 1957: September 1, one young 78 days old; September 2, two young about 70 days old; two families in 1960: August 22, one young about 70 days old; August 23, one young 75 days old. The two colour-banded young on Imrie Island were still on the islet with their parents on our last visit August 8, 1960, at about 50 days of age. For comparison, Webster (1941) observed two young two miles from the nest at 57 days of age, but they were still accompanied by their parents. These juveniles joined the local flock by the age of 67 days, but were still being fed by their parents. These notes underline the need of precise observation to determine age at fledging, departure from nesting islet, and independence.

Survival of eggs and young

The Race Rocks data (1956-60) yield hatching figures for 16 nests. Of the 38 eggs laid, 27 hatched (71%), the remaining 11 being accounted for as follows: six were lost in a storm, three disappeared, and two were addled. Hatching success on Mandarte was unreasonably low because of constant crow predation, increased by our frequent disturbance of the sitting birds when we moved about the island (19 eggs laid yielding five chicks, or 26 per cent hatching success).

Fledging data are available from observation of banded chicks on Mandarte (two pair for four seasons), Imrie and Halibut (one pair for one season each). In ten pair-seasons seven young were raised to an age of 50 days or older; thus each pair would produce 0.7 young per season on average. This is doubtless under the natural production in the area, as we consider crow predation on Mandarte abnormally high — in four pair-seasons here all eggs were lost to crows, so that no young were raised. Nevertheless our figure is considerably higher than that reported by Webster (1941) for the Siska region in 1940, where 24 pairs raised 10 young to fledging.

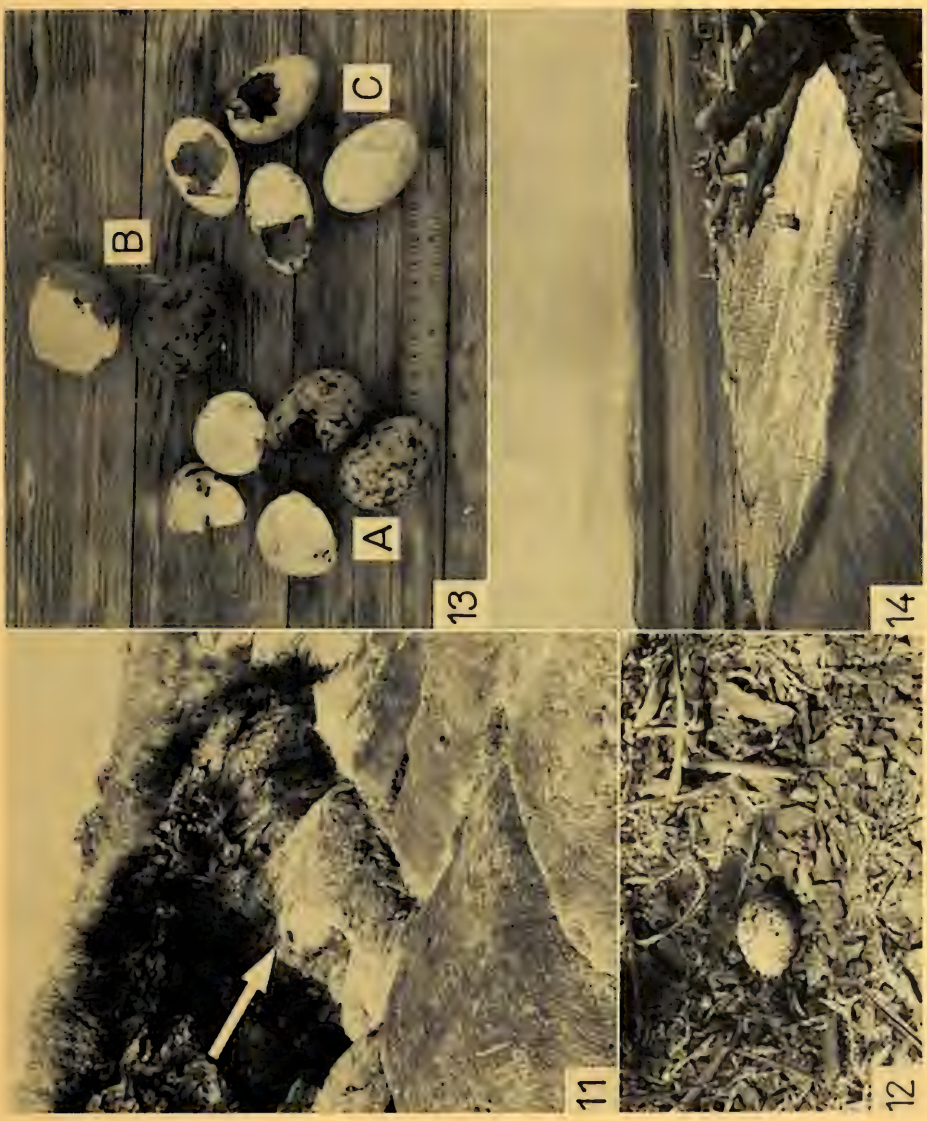

FIGURE 11. Nesting habitat of Black Oystercatcher on northeast beach of Mandarte Island (water's edge at bottom of figure). Arrow points to nest site.

FIGURE 12. The stone chip nest of the Black Oystercatcher of Figure 11.

FIGURE 13. Crow-pecked eggs, with a whole egg for comparison, of (A) Pigeon Guillemot, (B) Glaucous-winged Gull, (C) Cormorant spp.

FIGURE 14. Nesting habitat of Black Oystercatcher on Halibut Island; the nest was located at edge of beach debris in the centre.

Boyd (1962) has summarized production statistics for the European Oystercatcher (*Haematopus ostralegus*) from three studies, carried out in Wales, Germany, and Finland. In these three areas the number of eggs laid per female per season (as estimated by clutch size) was about 2.67, 3.01, and 2.88 respectively, hatching success 66%, 79% and 92% and success from hatching to fledging 75%, 05%, and 78%. In these three areas, therefore, a pair raised 1.3, 0.1, and 2.1 young to fledging on the average. Certainly part of this discrepancy can be accounted for by paucity of the data on fledging, but it does seem that success varies enormously between different areas.

4. *Larus glaucescens*, GLAUCOUS-WINGED GULL

Census and distribution

Available counts of the Mandarte colony (main island alone) run as follows (*see* Drent and Guiguet 1961: 57-59):

1915	450	pair, incorrectly given as 225 in the above
1921	350	pair
1923	600	pair
1927	1000	pair, a questionable estimate
1936	534	nests, a total count
1955	1500	pair
1957-61	1800-2000	pair
1962	2100	see Figure 2B, census area is 28% of occupied nesting grounds, assuming equal density total for Mandarte 2000, with an additional 100 on South Islet.

At present the Glaucous-wing nests in all open areas on Mandarte, and in addition a couple of pair nest on North Rock and about 100 pair on South Islet. The spectacular increase of this species on Mandarte is part of a general increase on the inner south coast of the Province (Drent and Guiguet 1961: 120). Protection and the increasing supply of food made available by man (especially refuse in nearby cities and harbours) are believed responsible.

Nesting habitat

All the less precipitous open areas of the island are utilized. The majority nest in the uneven grassy areas (Figure 8), and nests are regularly built in the brush fringe wherever the birds can penetrate by a sort of run-way. In addition, the Glaucous-wing nests at many points along the cliffy southwest shore, where its minimal requirements are intermediate between those of the Pelagic and Double-crested Cormorant. Young are successfully raised on rather narrow ledges and other precarious places, so that this species, like the Herring Gull (Goethe, 1960) can exploit a wide range of nesting sites.

Methods of gathering nesting data

In 1957 and 1958 nest recording on a large scale throughout the northeast side of the island was carried out by van Tets and his assistants (J. Takacs, D. M. Kennedy, and S. Shearman). About 1000 nests were recorded each season, and each was visited about every 2-3 days. The 1957 material forms

the basis for the census but has not been further used; the 1958 cards were analysed by D. Kennedy. In 1959 and 1960 effort was limited to the 'gull plot', an isolated unit of the colony bordered by beach and a dense growth of shrubbery, situated immediately south of camp and containing approximately 100 pair. In 1961 nest checks were made in several meadows on the northeast side, including the plot. In 1962 all meadows on the northeast side north of camp (489 pair in all) were checked.

In the first years all nests in the study area were marked by affixing numbered tin tags to nearby vegetation, a means not altogether satisfactory and replaced by wooden stakes in 1961. The nests were then checked as frequently as our other work permitted (GvT in 1959, 65 of 66 days in the laying-hatching period; RD in 1960, 41 of the 56 days in the laying-hatching period and 19 of 43 days thereafter; KV in 1961 and 1962, thrice daily in the laying-hatching period, daily thereafter). Record cards were completed for all nests in which eggs were found. The eggs were marked as they appeared with nest number and A, B, C successively, in India ink. The patrols on the plot in 1959-1960 required 1-1½ hours during laying, 1½-2½ during hatching, and 1 hour or less thereafter. In 1961 and 1962 with more meadows being checked the patrols lasted from 3 hours up to about 5 hours on busy days.

In 1959 the young were marked upon hatching by affixing poultry wing clips to the patagium, but the method proved unacceptable as it was not always possible to remove the marks without damage later on. In 1960 the young were marked upon hatching with legbands of coloured binders' tape, one combination for each brood. The age of the chicks could thus later be determined within the range of hatching dates of the brood (in most cases to within two days). When the chicks were sufficiently grown (15-30 days) these provisional marks were replaced with the standard aluminum rings supplied by the Canadian Wildlife Service. The checks were continued to the close of the season, and as many young as could be found in a careful search once over the terrain, recorded. The main weakness of the method was the impossibility of checking the young when they started to fly. In 1961 and 1962 the young received individual combinations of binders' tape, later replaced with individual colour combinations of plastic legbands in addition to the standard aluminum rings, allowing recognition from afar. By repeated checks with binoculars from blinds or shrubbery the fate of the young could be accurately followed to the close of the season.

Laying season

The first eggs appear on the island in the beginning of May, and in normal years the majority of clutches laid in the last week of June or later are replacements. Clutch commencement dates for the last four seasons have been plotted in Figure 15. Earliest dates of the four seasons were May 15, 20, 15 and 4, and laying was heaviest in the last week of May and the first two weeks of June. Taking the four seasons together, the central 80 per cent of the 934 first clutches were commenced in this three week period. The latest date for a clutch which resulted in fledged young was June 14, 1960; June 13, 1961; and June 30, 1962.

Clutch size and egg replacement

The normal first clutch for the Glaucous-wing is three, but smaller clutches do appear. It is impossible to be certain that an apparent clutch of two or one is not caused by predation etc., but we believe the following figures are representative for first clutches.

TABLE 10. — Clutch size of the Glaucous-winged Gull on Mandarte Island

	1959	1960	1961	1962	all years
Clutch size, three	65	65	77	400	607
two	17	21	15	71	124
one	9	5	5	8	27
Total clutches	91	91	97	479	758
Mean clutch	2.61	2.66	2.74	2.82	2.77

There is critical evidence for *Larus argentatus* and *L. fuscus* (Paludan, 1951) and *L. ridibundus* (Weidmann, 1956) that loss of eggs as they are laid causes protracted laying, i.e. the birds are indeterminate layers. Contrary results with *L. argentatus* (Davis, 1942) and *L. californicus* (Behle and Goates, 1958) are not supported by critical evidence. Besides this mechanism, loss of the entire clutch after brooding sufficient to suppress the fourth follicle has gone on, results in a replacement clutch (in *L. argentatus* and *L. fuscus* in 11-12 days, in *L. ridibundus* in about the same period).

Our observations on the Glaucous-wing indicate a similar response to egg loss. There are three records of protracted laying under natural circumstances, where loss of one of the original three eggs during the laying period led to the laying of a fourth egg, bringing the set up to three again. The most precise records are: no. 535, C egg laid June 2, lost June 2 or 3, D egg laid June 4; no. 571, A egg laid June 6, lost June 6 or 7, B, C, D followed on June 8, 10 and 14.

There are a number of records of replacement clutches, including four that appeared after the chicks were lost. In the first years none of the adults involved were marked, but in 1961 three indisputable records with colour-ringed pairs were obtained. Records for the interval from loss of the original clutch of three (when the nest was empty) to appearance of the first egg of the replacement clutch are six cases of 11 days, five of 12 days, one of 13* days, 13-14 days, 15* days, 16* days, and 17 days. (* denotes marked birds). These 16 cases give a mean of 12.5 days, which conforms to the interval found in other gulls (see above). Clutch size for 22 replacement clutches runs as follows: 10 cases of three, 9 of two, and 3 of one egg.

Incubation period

In the Glaucous-wing, the A egg hatches 1.7 days before the C egg on the average (49 observations), the B egg 0.9 days (45 observations), although they have been in the nest respectively four and two days before the C egg has been

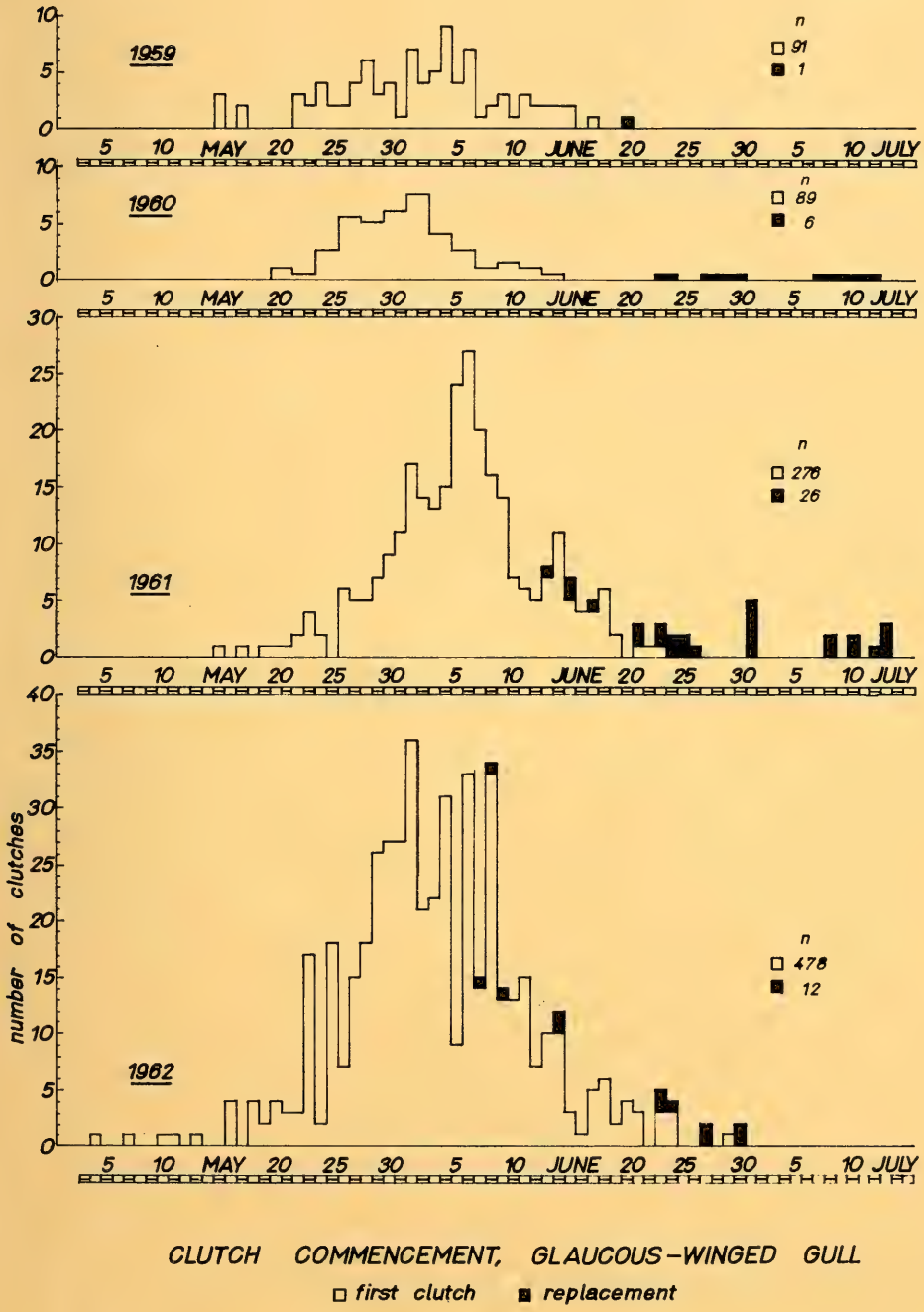

FIGURE 15. Clutch commencement of the Glaucous-winged Gull on Mandarte Island.

laid. Thus, as in other gulls (*see* Paludan, 1951; Barth, 1955; Ytreberg, 1958; Beer, 1962) incubation only gradually becomes fully effective, the first two eggs undergoing little development before clutch completion. Incubation period is best considered as the period between laying and hatching (i.e. young free of the shell) of the C egg. Sixty-seven records are available from marked C eggs in normal first clutches where both events were known to the nearest day, as set out below for a mean of 27.1 days.

TABLE 11. — Laying-hatching interval of C egg, Glaucous-winged Gull

26 days	17 eggs
27 days	31 eggs
28 days	17 eggs
29 days	2 eggs

Previous figures for incubation period in this species have been inadequately defined, and all lie below our values (Anderson, 1916: 24-25 days; Schultz, 1951: 23 days or less; James-Veitch and Booth, 1954: 23 days average, range 19-30 !).

Fledging period and colony departure

The age at first strong flight, strictly the fledging period to follow Moreau (1946), is distinct from the age at colony departure. The former was estimated as follows. When the observer enters the gull meadow the nearest adults take flight and settle on the water, and the chicks, depending on their age, either crouch in the cover or fly off to join the adults on the water. In 1960 the last age at which 39 chicks believed to have left the island successfully were found ashore averaged 40 days, with a range from 31 to 52. Doubtless some chicks avoided detection ashore beyond the last observation, but on the other hand some individuals though definitely capable of flight preferred to remain ashore in their habitual hiding place. We feel our mean figure of 40 days to be a useful approximation of the fledging period. Schultz (1952) reported that young Glaucous-wings attempt to fly at five weeks of age if disturbed, and can fly well by 45 days, conclusions with which our figures agree. James-Veitch and Booth (1954) give the average age at independent flight for 10 young as 46.5 days. A mean figure of 43 days was derived for the Herring Gull by Paynter (1949) from the same sort of data as ours.

The food available to the gulls along Mandarte's beaches is rather limited, and when the young begin to feed themselves they are forced to leave the island. It is possible that some of them utilize nearby food sources (e.g. Sidney Spit) foraging at low water and returning at first to roost at the colony. It is our impression, however, that in most cases once the juveniles leave the island they do not return, but gradually disperse to areas where food is readily available. One of these areas is Vancouver, 42 miles (68 km.) to the north, where sewage and garbage attract large numbers of gulls. Fortunately for us Mr. R. F. Oldaker has for some years been carrying out telescope observations in

Vancouver as part of the plumage and movements study organised by Mrs. Z. M. Schultz. By reading the band numbers Oldaker identified five of the juveniles from the study plot in 1960.

TABLE 12. — Mandarte Glaucous-winged Gulls sighted at the Vancouver city dump in 1960

Band no.	Nest	Last seen Mandarte		First seen Vancouver	
		Date	Age	Date	Age
577–20205	923	29 July	40 days	12 August	54 days
577–20216	923	27 July	38 days	12 August	54 days
577–20212	940	29 July	31–35	29 August	62–66 days
577–20237	986	3 August	31–32	8 September	67–68 days
577–20210	920	6 August	45 days	26 September	96 days

The two young from nest 923 (the third chick died in pipping) supply the most precise figures, being last handled ashore on the plot at 40 and 38 days old. It is not known how much longer these birds stayed at Mandarte, as we could expect them to take flight at the observer's approach beyond this age. Two weeks later, however, the birds were seen together (now 54 days old) foraging on the city dump in Vancouver, where the first of the season's juveniles was sighted August 8 (Oldaker). The fact that they were still together points to a strong bond between the siblings in this family, as occurs from time to time in the Herring Gull (Drost, 1951; Goethe 1955).

Indirect evidence on the age at colony departure is given by the age at which healthy young capable of flight were last seen on Mandarte. In 1960 four birds whose colour-marks were accidentally not replaced with aluminum rings were still seen on the plot at 53, 53, 53, and 60 days of age. For 1961 a considerable material is available based on colour-ringed young. There were no cases of departure before August 16, but there are 38 last sightings over the period August 20-28, ranging from 48-65 days old, with a mean of 56, the age at presumed departure. Some individuals probably escaped notice on days after their "last sighting", and that this figure is somewhat too low is shown by the ages of the 97 birds still present on the island the last two days of observation, August 29 and 30. The ages here ranged from 46-67 days, with a mean of 56, i.e. identical to the group presumed seen on their last day on the island.

We conclude that young Glaucous-wings begin to leave the colony at about 50 days of age, that most are gone by 60 days, and a few may remain until 70 days or older. Schultz (1952) found extensive flights with adults to occur at the end of the seventh week, and a gradual dispersal from the breeding colonies after the eighth week; again our figures are in substantial agreement. Herring Gull juveniles at typical colonies leave at about the same age (Goethe, 1955, 1956), as contrasted to the much longer periods at the Wilhelmshaven colony studied by Drost (1951, 1952), where ample food is available nearby the year round.

TABLE 13. — Last sightings of Glaucous-winged Gull young on Mandarte Island in 1961 (see text).

Age	20–28 August group	29–30 August group
45–49 days	3	9
50–54 days	13	32
55–59 days	16	37
60–64 days	5	15
65–69 days	1	4
total	38	97
mean age	55.7 days	55.5 days
range	48–65 days	46–67 days

Survival of eggs and young

TABLE 14. — Glaucous-winged Gull

Year	Total nests	Eggs laid		Chicks hatched			Young Fledged		
		Total	Per nest	Total	Per nest	% eggs	Total	Per nest	% chicks
1958	860	2232	2.6	1280	1.5	57%	780	0.9	61%
1959	92	244	2.7	156	1.7	64%	—	—	—
1960	87	225	2.6	150	1.7	67%	47	0.5	31%
1961	97	266	2.7	188	1.9	71%	95	1.0	51%

Figures from hatching success were obtained in four seasons, and show good agreement. Taking the four seasons together, 2967 eggs were laid in 1136 nests, from which 1774 chicks hatched, for an average hatching rate of 60 per cent. A break-down of egg loss is available for two seasons.

TABLE 15. — Analysis of failure to hatch, Glaucous-winged Gull

	1959		1961	
Addled	31 eggs	13% eggs laid	48 eggs	18% eggs laid
Disappeared	51 eggs	21% eggs laid	24 eggs	9% eggs laid
Died in pipping	6 eggs	2% eggs laid	6 eggs	2% eggs laid

The main cause for disappearance is crow predation, some eggs are taken by gulls, rolled out of the nest, crushed, etc. The figures suggest that the variation in hatching success in the various seasons may reflect varying predation (to some extent influenced by technique of the observer).

Fledging rate was determined in three seasons, but it must be emphasized that the methods differed. The 1958 data are based on the number of young

banded in the part of the island covered in the nest records. Every effort was made to cover the area thoroughly, and we made the practise of removing bands from any dead recovered on the island, and using these bands again. Therefore, the banding total should approximate the number of juveniles that reach flying age. The mortality between banding and flight is not extreme in any case; in 1960, eight of 59 or 16 per cent of the chicks banded on the study plot subsequently were found dead on the island. Applying this rate to the 1958 figures, the minimal fledging rate would be 0.8 young per nest. The rate of 0.9 given above is probably closer to the truth, however, because of our checks for dead juveniles, and the fact that some chicks must have been missed in the banding.

In 1960 a young was considered successfully fledged if seen in good health 30 days of age or older. This limit was chosen as some birds started to fly at this age. In total, 97 nests where eggs appeared were located on the plot; 87 of these gave reliable hatching data and were followed through to fledging. A check on these figures is provided by considering all the young fledged on the plot (55) versus the total number of nests (97), or a mean of 0.6 young fledged per nest.

The 1961 data are certainly the most precise, the number of young fledged being those still alive at 42 days of age. Mortality of the chicks is set out below.

TABLE 16. — Mortality of Glaucous-winged Gull chicks, 97 nests in 1961. N.B. young begin to leave colony after seventh week.

Age	Total dead	Missing	Found dead
First week	53	26	27
Second week	17	3	14
Third week	9	2	7
Fourth week	7	2	5
Fifth week	3	2	1
Sixth week	1	0	1
Seventh week	2	0	2
Eighth week	0		
Ninth week	0		
Tenth week	1	0	1
Totals	93	35	58

The high number of chicks entered as 'missing' in the first week is explained by their disappearance through predation, and to a minor extent by our failure to find the small carcases in the high grass.

Mortality is concentrated in the first days, as Paynter (1949) and Paludan (1951) found in *Larus argentatus*. In the Glaucous-wing practically 80 per cent of the deaths up to 49 days of age (when the young begin to leave the colony) occur in the first two weeks. No less than 28 per cent of all chicks hatched died in their first week. The chief death cause is predation or molestation by adult gulls (not the parents). Of the 58 carcases found, death cause could be ascertained for 16, as follows: 14 pecked to death by gulls, of

which four had been partially eaten, one killed by fall over cliff, and one crushed by the observer. The importance of the crow as chick predator is unknown.

Hatching and fledging rates for other *Larus* gulls are set out in Table 17.

TABLE 17. — Hatching and fledging success in *Larus* gulls

Species	Hatching (% eggs laid)	Fledging (% chicks)	Authority
Larus fuscus	94%	55%	Darling (in Paynter)
	61%	5%	Paludan 1951
L. argentatus	92%	41%	Darling (in Paynter)
	71%	51%	Paynter 1949
	56%, 90%	20%	Paludan 1951
L. californicus	87%	70%	Behle & Goates 1957
L. ridibundus	75%, 78%	—	Ytreberg 1956

A closer comparison with the figures for *L. argentatus* is rewarding, as these were obtained from a reasonably large material, with methods similar to ours, in habitat not strikingly different (Paynter, 1949; Paludan, 1951; Drost *et al.*, 1961). Paludan's data for *L. fuscus* can be disregarded here, as he studied a declining population whose low success was due to predation by the Herring Gull nesting at the same colony.

TABLE 18. — Reproductive success in 4 gull studies.

Species	Colony	Study period	Production per season per 100 nests			
			Eggs	Hatched	Fledged	Authority
argentatus	Graesholm	1943–44	300	270	54	Paludan 1951
	Kent I.	1949	247	176	91	Paynter 1949
	Wilhelmshaven	1948–59	267	—	66	Drost *et al.* 1961
glaucescens	Mandarte	1958–61	261	156	89	This paper

It appears that the Glaucous-wing has a lower hatching rate and a higher fledging rate than the three colonies of the Herring Gull investigated. More data are needed to show if these differences are real, however, for the *argentatus* material is small (Paludan 90 pairs, Paynter 100 pairs) and the only fledging data extending over several seasons (Drost) shows the same range of variation as the Glaucous-wings at Mandarte. The Wilhelmshaven colony increased from 107 to 139 pair in 1956-59, and in those four seasons the fledging rate per pair varied from 0.4 to 0.9 young. In fact, when the difficulties are taken into account, the data from the various studies are remarkably similar.

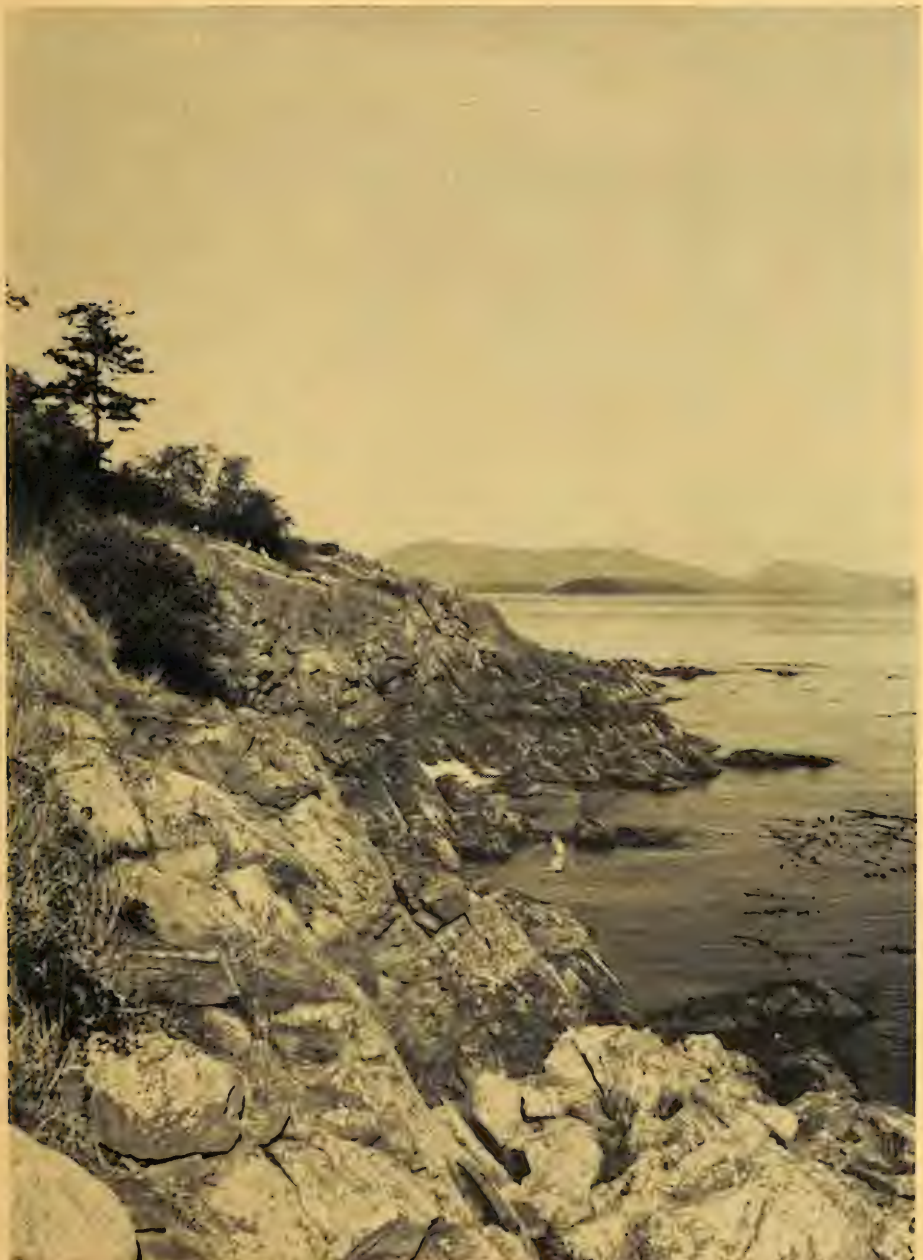

FIGURE 16. Boulder beach and low cliff along Mandarte's northeast shore, nesting habitat of the Pigeon Guillemot (11 nests in the portion shown).

5. *Cepphus columba*, PIGEON GUILLEMOT

Census and distribution

Though known to have nested on Mandarte since at least 1902 (Drent and Guiguet 1961: 78) there are no adequate counts previous to 1957-1960. In this period we attempted to locate all nests on the island, and as these are used year after year practically all nests (certainly more than 90 per cent) were known by the close of 1960. The total of 102 was distributed as follows: three on North Rock, 80 on Mandarte itself, and 19 on South Islet. We obtained definite evidence that at least 82 were occupied in the 1960 season, whilst seven had become unusable and the balance were probably occupied. Bearing in mind that all nests were not found, we estimate the breeding population at Mandarte at 100-110 pairs. Distribution of known nests is shown on Figure 2A. It is our belief that the colony has reached maximum size, all available nest-sites being in use.

Nesting habitat

The Pigeon Guillemot has a strong tendency to lay its eggs under cover. Only once did we obtain a record of an open ledge site on Mandarte (1960). Bowman (1961) reported a similar observation from South Farallon, California.

As the thin rocky soil on Mandarte precludes extensive burrowing the guillemots utilize all manner of natural holes and crannies. These can be grouped in four categories, the relative importance being indicated by the number of nests of each type found on the northeast short of Mandarte (total 62 nests): (1) cavities or chambers in loose boulder jumbles along the beach (24 nests), (2) natural cracks in rock masses (18 nests), (3) chambers in the soil beneath a boulder cap, usually a natural hollow enlarged by the birds (14 nests), and (4) abandoned rabbit burrows (5 nests), originally excavated by *Oryctolagus cuniculus* introduced to the island long ago but extinct there when our study began. Further possibilities such as beach debris, although used in the vicinity, do not occur on Mandarte.

On those parts of the island thoroughly worked by us we found nesting guillemots wherever cavities occurred, at all elevations and in a variety of situations including nesting groups of cormorants and gulls. The only limitations appeared to be that dense brush was avoided and the birds were generally prevented from using burrows within one meter of an occupied gull nest.

Laying season

Figure 17 shows the dates of clutch commencement for the seasons 1957-1960 on Mandarte. Taking the four seasons together, the 124 clutches give a mean date of June 11, standard deviation of eight days, and a range of 42 days (May 18-June 29). Young have successfully fledged from eggs laid at each extreme (May 18, 1960; June 28, 1959). These dates are doubtless near the limits for this area. Bowles (1921) assembled the data of Washington oölogists and found the earliest date for a fresh complete clutch was May 20, the latest July 2. Thoresen and Booth (1958) report laying in 1957 to have commenced about May 20 with a peak June 5-20, for the Fidalgo Island area in Washington,

not far from Mandarte. In our experience single fresh eggs in July have been replacements.

Methods of gathering nesting data.

We found the afternoon hours the best time to check the guillemot nests, as the unoccupied birds are then absent from the colony and thus our disturbance could be kept at a minimum. The nests along the northeast side of the island formed the study group, being checked every 1-3 days in 1957-1958 (GvT, Takacs, Kennedy) and daily throughout the 1959 and 1960 seasons (RD). The number of nests covered in these four seasons where at least eggs appeared was 33, 32, 45, and 45 respectively. The nests on South Islet (similarly 9, 9, 15, and 18 nests respectively) were checked from six to fourteen times during the season, and nests elsewhere were visited only for banding of the young.

Clutch size and egg replacement

Quantitative data for clutch size are given by Winn (1950) for the closely related Black Guillemot on Kent Island (New Brunswick) and Thoresen and Booth (1958) for the Pigeon Guillemot in the Fidalgo Island area, Washington, as set out in Table 19. The Mandarte data are given in Table 20. The usual

TABLE 19. — Clutch size, data of Winn and Thoresen & Booth

	Black Guillemot	Pigeon Guillemot
one egg	9	9
two eggs	39	33
three eggs	1	

TABLE 20. — Clutch size of the Pigeon Guillemot at Mandarte Island

	1957	1958	1959	1960	Totals	Per cent
one egg	4	2	4	5	15	9.3%
two eggs	33	32	36	46	147	90.7%
mean clutch	1.87	1.94	1.90	1.90	1.91	

clutch of the Pigeon Guillemot thus consists of two eggs. Replacement clutches and nests established over the seasons as being prone to crow predation were disregarded for the tabulation, so the proportion reported for clutches of one (about 10 per cent of the total 162) should be near the truth. These were deposited during the normal egg-laying period, and of the 15 eggs nine hatched, eight of the chicks subsequently fledging successfully. Thus one-clutches appear normal in every respect.

Two records where more than two eggs appeared in the nest were definitely the work of two females (banded individuals), birds whose nest had

become unusable laying in the nearest available cavity along with the nest owner. This is doubtless the explanation for the 3-clutches occasionally reported for Black and Pigeon Guillemots, as these records are not supported by critical evidence.

No replacements were noted if only one of a two-clutch was lost, and if the entire clutch was lost a repeat clutch appeared in approximately 13 days (eight observations, seven of one egg, one of two eggs) in about half of the cases. Four of these repeat clutches were lost in turn, but in no case was a third attempt made.

For the Black Guillemot Winn (1950) recorded two repeat clutches in 15 days or less, and Uspenski (1958) records one 18 day interval. For the Pigeon Guillemot Thoresen and Booth (1958) estimate two cases at 18 days. All auks studied replace lost eggs in a pattern comparable to repeat clutches in other birds (*Alca torda, Uria aalge* and *U. lomvia, Fratercula arctica*: Paludan, 1947; Uspenski, 1958; Nørrevang, 1958; Tschanz, 1959; Kartaschew, 1960).

Incubation period

Laying-hatching intervals were determined for 22 marked eggs of the Pigeon Guillemot, where both events were known to the nearest day.

TABLE 21. — Laying-hatching intervals in Pigeon Guillemot

	A	B
28 days		2
29 days		3
30 days		3
31 days	5	1
32 days	2	2
33 days	3	
34 days	1	
Total eggs	11	11
Mean (days)	32.0	29.8

As the eggs are laid with an interval of three days, the figures indicate that little effective incubation occurs before the second egg is laid. Temperature recording demonstrated that steady incubation does not set in until some time after clutch completion. The incubation period of the Pigeon Guillemot can thus best be regarded as the period required to hatch the B egg, that is, 30 days on the average, with a range of 28-32.

Comparable figures from the literature are scant. Winn (1950) gives 12 records for the Black Guillemot, but does not specify interval from laying to hatching in seven, and does not distinguish A from B eggs in the other five (29, 30, 32, 33, 33 days). Uspenski (1958) gives 27-30 days as the incubation period for this species (B egg). Thoresen and Booth (1958) report four cases of 31 days for the B egg in the Pigeon Guillemot, but do not state probable error of their observations.

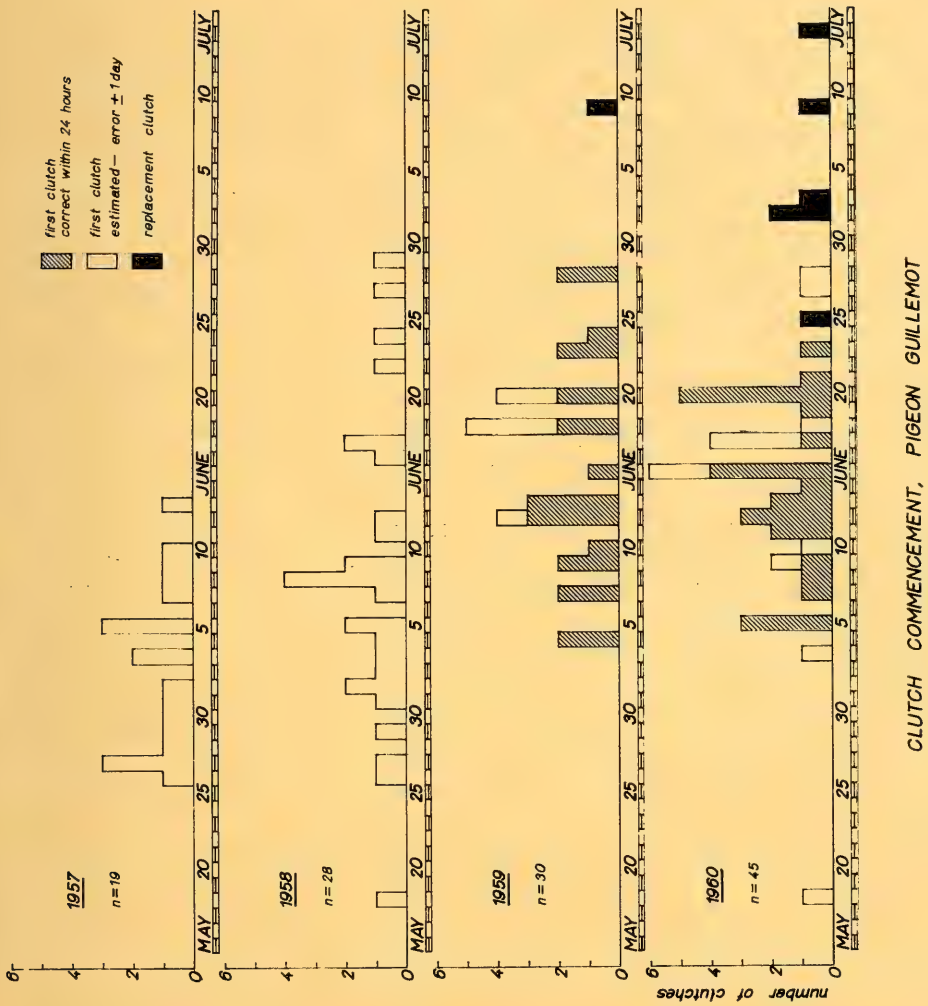

FIGURE 17. Clutch commencement of the Pigeon Guillemot on Mandarte Island.

Nestling period

The chick does not leave the nest cavity until close to adult weight (90 per cent on average) and with complete juvenal plumage. Potentially at least the young are then capable of flight, so here nestling and fledging periods coincide. As was confirmed by releasing advanced young by day, the young leave the colony directly and have nothing further to do with their parents who continue to join the colony assembly long after the chicks have departed (observations on banded birds).

Fifteen observations of the nestling period on Mandarte range from 29 to 39 days, with a mean of 35 (29 days-2, 30-1, 33-2, 34-1, 35-1, 36-2, 37-2, 38-2,

39-2). In each case the chick was last seen in the nest the afternoon or evening of the day given (being absent the following day), and it is presumed that it left the nest the same evening, though this event was never witnessed.

For the Black Guillemot in the Russian Arctic Uspenski (1958) gives two observations, 34 and 36 days, and quotes Kaftanowski that the nestling period is 35-37 days, a figure reappearing in Kartaschew (1960). For Iceland Gudmundsson (1953) gives five weeks. Winn (1950) reported one period of 39 days, and two chicks that had not yet left the nest at 36 and 37 days, in the Bay of Fundy. For the Pigeon Guillemot Thoresen and Booth (1958) state the nestling period to be 33-37 days (number of observations not given) for Skagit County, Washington. It will be seen that the Mandarte material is the largest, and that determinations elsewhere fall within the range of our data.

Survival of eggs and young

A difficulty in employing the data was to decide whether our visits had influenced nesting success. This involved a number of decisions based on intimate knowledge of the nests and we believe gross errors have been eliminated. A special problem was to decide if capture of the adults on the eggs for banding purposes caused desertion. In fact of the 40 cases analysed a significant increase in hatching failure occurred in nests where the adult was captured in the first days after laying (especially up to nine days). For this reason nests where an adult was captured within the first 19 days after clutch commencement have not been included here.

TABLE 22. — Hatching success in the Pigeon Guillemot

	Nests	Eggs	Chicks	Per cent
1957	26	50	37	74%
1958	21	41	25	61%
1959	28	50	27	54%
1960	34	59	35	59%
all years	109	200	124	62%

Hatching success in the four seasons does not differ significantly ($p < .05$).

TABLE 23. — Analysis of failure to hatch, Pigeon Guillemot 1957–60.

Cause	No. of eggs	% eggs laid
Addled	36	21%
Taken by crows	26	15%
Rolled out of nest	7	4%
Died in pipping	1	½%
Unknown	1	½%

Analysis of hatching failure was possible only for the nests on the main island, where 172 eggs yielded 101 chicks over the four seasons (South Island data are

included in Table 22). The 71 eggs failing to hatch are grouped in Table 23, showing that addling and crow predation account for most of the failure. The category 'addled' covers infertility and embryonic death, which could not be distinguished in the field. Crow predation is heaviest in the first few days of incubation, as shown in the following table where day 0 is the day of clutch commencement.

TABLE 24 — Time of egg loss to crows in the Pigeon Guillemot

Day	Number of eggs lost
0– 1	4
1– 2	4
2– 3	4
3– 4	2
4– 5	1
6–24	0
25–30	2

By temperature recording it was determined that steady incubation by day sets in the day following clutch completion (thus day 4), and by night from 4/5 to 7/8. The table makes clear that crows are likely to take eggs only in the period when they are not continuously covered by the parents. The two observations at 25-30 days were special cases where the parent had accidentally dislodged the egg to the burrow entrance where it was taken by crows before the guillemot could roll it back into the nest.

TABLE 25. — Fledging success in the Pigeon Guillemot

Year	Nests	Hatched	Fledged	Per cent
1957	22	38	35	92%
1958	15	24	21	88%
1959	18	29	26	90%
1960	28	44	18	41%
1957–59	55	91	82	90%

Considered successfully fledged were healthy chicks that disappeared from the nest having attained juvenal plumage and juvenile weight (34 days of age or older). It will be seen that 1960 was an unusually poor year. This was due to a vastly increased mortality through molestation by juvenile gulls. In this season no less than 15 guillemot chicks were pecked to death by juvenile *Larus glaucescens* that had chanced to scramble into the guillemot nests for shelter. The explanation for the heightened mortality is found in the weather: 1960 had a prolonged dry spell, no measurable rain falling on Mandarte between June 20 and August 14. This dry, hot weather had a drastic effect on the

vegetation, so where normally clumps of grass and shrubbery would answer the needs of the gull young, they now had recourse to natural crannies in the rock, including occupied guillemot nests.

In summary, in a "normal" year hatching success for the Pigeon Guillemot at Mandarte lies at about 62 per cent (mean 1957-1960) and fledging success at about 90 per cent (mean 1957-1959), such that each pair on average will lay 1.9 eggs, hatch 1.2 chicks, and raise 1.1 young to nest departure. The corresponding percentages of Thoresen and Booth (1958) for the Pigeon Guillemot in Skagit County, Washington, in 1957 (54% hatching success, 86% fledging success) and of Kartaschew (1960) for the Black Guillemot in the Murmansk region (eggs to fledged young 60%), both based on a much smaller material, show good agreement with our figures. Winn (1950) gave statistics for the Black Guillemot in the Bay of Fundy in 1947. He found a similar hatching success (52%) but a low fledging success (no more than 50%). Most of the chick loss (82% in fact) occurred by flooding of the nest during storms, and suggests that 1947 was an unfavourable year for the Black Guillemot in the Bay of Fundy, just as 1960 was a bad year for Mandarte's Pigeon Guillemots, but for a very different reason.

6. *Lunda cirrhata*, TUFTED PUFFIN

Known to nest on Mandarte since at least the turn of the century, few counts of pairs are available, and still fewer finds of eggs or young (*see* Drent and Guiguet 1961: 113-115):

> 1908, 1 nest (egg 25 June), about 1910 no more than 3-4 pair, 1915 3 pair, 1916 4 pair, 1922 2 pair, 1927 15 pair (we question this estimate), 1936 2 pair, 1 nest (egg 12 June), 1940 1 nest (egg about 20 May), 1953 1 pair, 1955 2 pair, 1957-62 at least 2 pair, 1 nest in 1958 (egg 3 July), 1 nest in 1959 (chick 25 July), 2 nests in 1960 (egg 31 July, chick 2 August), 1 nest in 1962 (chick 10 August).

Apparently the Tufted Puffin has been a regular breeder on Mandarte over the past 50 years. The only suggestion that there have ever been more than a couple of pair or at most four pair nesting here is Munro's (1929) estimate in 1927 which was almost certainly too high. Munro did not mention puffins in the accounts of his 1921 and 1923 visits, and gave two pair for 1936 (Munro 1937).

FIGURE 18. Stone chip nestbowl of the Pigeon Guillemot with full clutch of two (wired for temperature readings).

FIGURE 19. Pigeon Guillemot nest cavity in boulder jumble along northeast beach, Mandarte Island. Arrow points to clutch of Figure 18.

FIGURE 20. Passerine nesting habitat on Mandarte Island: at shrub edge in foreground (chiefly Waxberry) a Song Sparrow nest, at base of Saskatoon Berry thicket on right a Northwestern Crow nest.

FIGURE 21. Mandarte Island, looking northwest along island crest: on left the cliff brow, followed by an open grassy slope, adjoined by the shrub and tree belt: the clump silhouetted consists of Arbutus, Douglas and Grand Fir, with Willow understory. Shrubbery is formed chiefly by Saskatoon Berry and Waxberry; in left foreground Fireweed.

19

18

21

20

Two pair have been seen regularly about the island in the last years, and by 1960 we had located two nests (see Figure 2A). The Tufted Puffin generally excavates a burrow, but as no suitable terrain exists on Mandarte both nests were found in natural crevices in the rockface. Use of similar sites has been reported from the nearby San Juan Islands (e.g. Dawson and Bowles, 1909). The north site on Mandarte has been in use for at least the past four seasons. In 1959 a single downy young was found and banded July 25, and was apparently still being fed August 22. In 1960 a single young was banded August 2, and had left the nest by August 31. In 1961 adults were present at the site but the nest was not checked. In 1962 another young was banded on August 10. The records from this nest suggest that the Mandarte colony may be able to maintain itself without immigration from other colonies. Puffins visited other crannies on the cliff-face, but we found only grass accumulations at these sites; possibly a third pair is implicated.

Eggs have been found on Mandarte from about May 20 to July 31, and chicks from July 25 to August 22. As in other puffins, the clutch consists of one egg. The Tufted Puffin is seen at Mandarte only in the breeding season (arrival dates in 1959 and 1960: May 6 and 13 respectively), departing again in early September (no exact dates).

7. *Hirundo rustica*, BARN SWALLOW

The Barn Swallow is a recent addition to Mandarte's breeding species. The species is known to rely heavily on human habitation for nesting (e.g. Nordberg, 1950: 22), and the building of cabins on the island provided a natural experiment in habitat selection. In 1957 a small cabin was constructed, in August 1958 the frame of another. In 1959 the Barn Swallow was first noted on the island, being seen on 15 days in the course of the season (usually one, maximum of three individuals), during which the second cabin was completed. In 1960 the Barn Swallow was noted 39 times (usually two, maximum of three individuals) and at least two birds regularly flew into the second cabin in the period May 24-June 21, to perch on a roof-beam. In 1961 one pair nested on this beam, the mud necessary for the nest being brought in from elsewhere, probably Sidney Island. At least three young left the nest successfully.

In 1962 a pair of Barn Swallows nested in the same site. On May 10, the birds were seen for the first time about the cabin, on May 11 they inspected the ledge, starting nest-building on May 17. Laying commenced June 3, but the female was disturbed and the second egg was not laid until June 6, and the clutch of five was completed on June 9. Two nestlings hatched June 26, the remainder June 27. Four young survived to leave the nest on July 17, returning on July 18, but permanently gone by July 23. On July 26 the first egg of the second clutch was laid, the last of the five eggs being laid July 30. Hatching occurred August 15-16, and the five nestlings were close to fledging when the observer left the island August 31. Assuming that the eggs hatched in the order laid, incubation period (E egg) for the first clutch was 18 days, for the second 17, rather longer than the 14-15 days given by Kendeigh (1952: 245) as usual for the species. Probably the frequent disturbance of the sitting bird (the cabin served as kitchen) is the explanation. Nestling period (hatching to

first departure) for the first clutch was 20-21 days for the various young, Kendeigh (1952) gives 20-22 days for *H. r. rustica* and 18-20 for *H. r. erythrogaster.*

8. *Corvus caurinus* NORTHWESTERN CROW

Census and distribution

The crow has had a rather chequered career on the island, as wardens posted intermittently from 1915 on made a practise of shooting the birds. However the species is an abundant local nester, and doubtless was always able to exploit the Mandarte sea-birds as a food source (cf. Munro, 1937). In our period on the island approximately 20-25 pair have nested every season, the most complete coverage of the island being attained in 1960 when a trail was cut through the brush (minimum 20 pairs: 21 nests located of which two probably were replacements, and at least one missed). Figure 2B shows the location of crow nests in 1960.

Nesting habitat

All nests save one were located in the shrub and tree belt, the exception being a nest built in 1960 on the ground in a recess between two boulders on an uneven grassy slope at the north end of the island (eggs were laid but deserted). The remainder fall into three categories: (1) nests built on the ground, and hidden in dense thickets, the most difficult type to find; (2) nests built in dense shrubbery (especially Waxberry, Wild Rose, Saskatoon Berry) about 1-1½ meters off the ground, often below a snag or tree serving as perch; and (3) nests built in trees (Douglas Fir, Grand Fir, Saskatoon Berry) at 3 meters up to about 7 from the ground. The tree nests were always so built as to be obscured by foliage, an especially noticeable feature in the older Douglas Fir where bare limbs prevail. Garry Oak appear to be unsuitable nesting trees. As an indication of frequency, in 1960 there were five ground, eight shrub, and seven tree nests, and the one boulder site. Darcus (1930) has described ground nesting of this species in the Queen Charlotte Islands.

Methods of gathering nesting data

Casual search for crow nests was carried out in 1958 and 1959 (nine and ten nests respectively), and trail cutting enabled thorough search in 1960 (21 nests). The objective in the first three seasons was banding of the young, the usual aluminium rings being supplemented by plastic colour rings from 1958 on. In 1960 the nests were visited more frequently to obtain figures on nesting success, and effort was made to follow the fate of the colour-banded young to the close of the season. A handicap in working with the crows was that visits during egg-laying caused desertion.

Laying season

Dates of clutch commencement (to the nearest week) have been determined for 18 of the 21 nests found in 1960 (three from laying dates, 15 from hatching dates) as follows:

April 23-30 5 clutches

May	1-7	6 clutches
	8-15	1 clutch
	16-23	3 clutches
	24-31	1 first clutch & 1 renesting
June	1-7	1 first clutch & 1 renesting

It will be seen that 11 of the 16 first clutches were commenced in the last week of April and the first week of May. The two renestings were replacements for nests disturbed by us in the laying period, and have been included in the data below.

Clutch size

Eight reliable figures for clutch size are available from nests located shortly after clutch completion:

three eggs	1 clutch
four eggs	4 clutches
five eggs	3 clutches

The clutch of three was laid in the first week of May. Over-all mean is 4.3, comparing to 4.5 reported by Black (Kendeigh 1952:244) for *Corvus brachyrhynchos.*

Incubation period

We have no figures; Kendeigh (1952:245) quotes Black (*MS*) for an incubation period of 19 days in the closely related *C. brachyrhynchos.*

Nestling period, fledging, and independence

Six nests provide data on the age at which young leave the nest. This is a gradual procedure, the young first perching on the nest rim, then on nearby twigs, returning to the nest from time to time. Age differences in the brood have been disregarded for the following determinations:

3 young at 20-23 days
2 young at 25 days
3 young at 27-29 days
3 young at 31-33 days
3 young at 30-32 days

The two shortest periods were recorded from nests built on the ground, the remainder from shrub nests at 1½ meters from the ground. The 14 young give a mean nestling period of 28 days, in accord with figures for *C. brachyrhynchos*, for which Kendeigh (1952:245) cites Black for a nestling period of 27 days, and Parmalee (1952) gives four to five weeks.

The young are uncertain in flight in the first days after leaving the nest, but probably all normal young can fly to some extent. Occasionally young incapable of flight were captured after nest departure, but as some were sickly at the time, and all died within a few days, this flightlessness can be considered abnormal.

The period of at least partial dependence on the parents for food seems gradually to come to a close about a month after nest departure. The following

observations on colour-banded nestlings in 1960 are pertinent:
no. 23: foraging alone on beach 55 days old, seen begging 56 days old
no. 26: do. 60
no. 43: do. 58
no. 72: seen being fed 63 days old, begging at 69 days old
Parmalee (1952) reported that young *C. brachyrhynchos* were fed by the parents in the first one to three weeks after nest departure.

Survival of eggs and young

Desertion occurred in five of the 21 nests in 1960, and these have been omitted here (our disturbance was responsible in four cases). Six nests provide data on hatching success: from 25 eggs laid 22 chicks hatched (88%), two of the eggs failing to hatch and one disappearing during incubation. Eight nests supply figures up to nest departure: of 28 chicks hatched 22 left the nest successfully (79%). Age at disappearance was established for five of the six young lost in the nestling period, and all were less than 10 days old. Further, all of the five disappeared from nests where four young hatched. We noted asynchronous hatching in these broods, the last-hatching young being recognizeable as a 'runt' or 'dwarf' compared to its siblings. This is explained by incubation setting in with the third egg (Black in Kendeigh 1952:245). We assume that it was the 'runt' that died in these five nests, but this is established for only one nest.

Asynchronous hatching in Corvids among others is considered to be an adaptation to allow raising a large brood in years of exceptionally favourable food supply without endangering the survival of a smaller brood in other years, in which the bonus young will speedily be eliminated by starvation (cf. Lack 1954:40-41).

Among Corvidae the colonially-nesting Rook has received much attention; it will suffice here to point out that nesting success is comparable to that in the Northwestern Crow. In the Rook hatching success varied from 80 to 91 per cent, survival at nest departure from 66 to 79 per cent, in a large material over a six-year period as summarized by Owen (1959).

In 1960 fate of the young after nest departure was followed. Thirty-three nestlings from 15 nests were colour-banded, of which 10 were subsequently recovered dead on the island, 18 were observed to the close of observations (end August), and the remaining five were not accounted for. To estimate the mortality in the first month after nest departure, 11 nests where fate of the young was accounted for have been selected. In this group 25 young left the nest successfully, and 18 (72%) were still alive at an age of 60 days. Of the seven young dying, three became sick and died at the ages of 36, 47, and 69 days. The birds gradually lost the ability to fly, and spent the last day or so hopping about in the underbrush, eventually becoming immobile and dying. The remaining four died of unknown causes, the dessicated carcasses of three of them being recovered during gull banding, and the last disappearing after the age of 30 days from a family closely watched. In 1959 we observed adult gulls to attack and kill a crow just out of the nest, after it had wandered into the gull meadow, and the circumstances of recovery of four of the seven crow car-

casses in 1960 suggest a similar fate. We believe the chicks so attacked were abnormal, similar to the uncoordinated birds we were able to capture in the shrubbery after nest departure – as noted above, these all died later.

When observations were closed 15 crows from nine nests had reached an age between 90 and 100 days, and three young from two nests an age between 60 and 70 days. In the group of nine nests, 20 young had left the nest successfully, so the 15 remaining two months later represent 75 per cent.

9. *Agelaius phoeniceus*, RED-WINGED BLACKBIRD

Although resident on the island at least in the early summer of every season 1957-1959, the first breeding evidence was secured in 1960. At least three males and two females were present on the island when we arrived May 5, on May 8 an abandoned nest was found, and on the morning of May 16 nestbuilding was observed. When located that afternoon, the fresh nest was virtually complete but the pair was continuously disturbed by crows and eventually deserted. No Red-wings were seen on the island thereafter until three males arrived on June 21, remaining until June 28 (one of them had yellow epaulets and was thus recognizeable). Finally, at the close of the season an old nest was found at the north end. We feel that at least three pair made efforts to nest on the island in 1960; two were certainly unsuccessful and the other probably so.

In 1961 at least one pair was present when we paid a brief visit March 17-20, and a maximum of four males and three females was observed in the first two weeks of May. By May 20, three males on territory remained, and two nests were located in the course of the month. In one, building was observed on May 5, and the nest held four eggs May 21, all hatching on May 28. When visited again June 3 the nest was empty, probably due to plundering by crows. The second nest contained four young, about two days old, on May 29; and on June 3, two young remained when the nest was visited for banding. Thus certainly two pair and probably three nested on Mandarte in the 1961 season. In 1962 at least one pair raised a brood, but further data are lacking.

The five nests (three in 1960, two in 1961) were all located in the shrubbery, and were built 1-1.5 meters off the ground in Waxberry bushes. In the Sidney area the only other island on which we found Red-wings was Imrie Islet, where a nest with a single well-grown young was found in low brush June 19, 1960, and adults observed in other years. The vegetation on this islet, which also harbours a sea-bird colony, is closely similar to that on Mandarte. Islands we visited often enough to be certain of Red-wing absence are Halibut, Rum, Gooch, Rubly, Domville, Forrest, and the smaller Reay, Greig, and Dock.

C. J. Guiguet informed us that the Red-wing is a common though not abundant breeder in similar habitat in the Victoria area (several low dry islets in Oak Bay region, Gordon Head, Albert Head, etc.). Orians (1961) notes nesting on an arid island in San Francisco Bay, so the Mandarte situation is by no means exceptional.

10. *Melospiza melodia*, SONG SPARROW

Casual observations in our first seasons on the island indicated the Song Sparrow population on Mandarte to be unusually dense, and prompted a popula-

tion study, begun in 1960 and still in progress. Findings from the first three seasons will be briefly reported here.

Methods

Essential to the study was the marking of as many Song Sparrows (both adult and juvenile) as possible. The birds were captured for the most part in Japanese mist nets, set up along trails cut through the shrubbery. A few juveniles were caught in a wire box-trap, and several by chance in our cabins. The banding of nestlings was found to bring about an increase in mortality, either by leading crows to the nest, or by causing premature nest departure, and was therefore kept to a minimum. Where possible the history of individual nests was followed and the young banded soon after fledging.

Mist-netting was found highly effective. By the close of the first season more than half, and by the end of the second (when including the birds ringed as juveniles in the previous year which had survived to breed) more than 90 per cent of the adult population had been ringed. In total 103 adults, 32 nestlings, and 406 fledglings (or juveniles) were ringed in the three seasons.

All birds received standard aluminum rings together with one or two plastic colour bands. By using eight colours in different combinations each bird could be recognized individually.

Census work was carried out continuously during the three summer seasons, and at spaced intervals in the intervening winters (four visits in 1960-1961, seven visits in 1961-1962).

Numbers

The composition of the adult Song Sparrow population on Mandarte is shown in Table 26. The figures for 1960 are approximate within the limits given, as but few birds had been marked at the onset of breeding. The situation was closely similar in 1960 and 1961, but 1962 was markedly different. Although the breeding population showed a slight decline in 1962, 25 unmated males were present, so that the total population showed a 12 per cent increase over 1961. It should be mentioned, however, that the 1962 figures characterize only a few days at the beginning of breeding. The high frequency of unmated birds in the population led to territorial fights throughout the season, and resulted in the death of some males and the desertion of others. By mid-summer the number of adults on the island approximated the level of previous years.

TABLE 26. — Adult Song Sparrow population on Mandarte Island at the onset of three successive breeding seasons.

Status	1960	1961	1962
Breeding male	46–48	47	44
Breeding female	46–48	47	44
Unmated males a) territorial	4–6	5	17
b) floating		2	8
Total adult population	96–102	101	113

That territorial behaviour is believed to play a very important role in regulating the size of the Mandarte Song Sparrow population has been discussed in an earlier paper (Tompa, 1962).

Territory and habitat utilization

The habitat on Mandarte can be divided into three zones: (1) bare rock and cliff surface along the shoreline, (2) grassland, and (3) shrubbery, including small groups of trees. Although the first two of these zones are frequently utilized by foraging Song Sparrows, most other activities are confined to the shrubbery, which provides shelter, concealment, and also nesting and mating grounds including singing and perching posts for the males. Territory defense is extended only to the shrubbery area of a male (or breeding pair) and its immediate surroundings, and this actively defended area has been considered the territory proper, in distinction to the foraging areas outside the shrubbery which often overlapped (for a fuller discussion see Tompa, *in press*). The grouping of territories is dictated by the configuration of the shrubbery (see Figure 2C and D). Nests are generally built along the shrub edges, either in a tuft of grass just off the ground, or up to about 0.5 meters in shrubs.

The shrub areas on Mandarte have been accurately measured, and come to a total of 14,100 square meters. The amount of shrubbery utilized by Song Sparrows in each season is known, and by using the population census the mean territory size for 1960 and 1962 has been calculated (Table 27). In 1961 all territories were measured individually (Tompa, 1962) when territories of 47 breeding males were found to range from 110 to 400 square meters (mean 288), of five unmated males from 65 to 105 square meters (mean 82). The overall mean was 268 square meters.

Comparing the three seasons, the effect of the increased number of territorial males in 1962 is evident: the average territory size was smaller, and isolated patches of shrubbery not utilized in the previous years were occupied (compare also the territory maps).

TABLE 27. — Mean territory size of Song Sparrows on Mandarte Island

Year	Number of territories (Mated and unmated ♂♂)	Area of shrub utilized	Mean territory size
1960	50–54	13,946 m²	c. 268 m²
1961	52	13,946 m²	268 m²
1962	61	14,050 m²	230 m²

Figures for Song Sparrow territory size for a number of localities in Eastern North America are available for comparison, as set out in Table 28. (Figures originally given in acres have been converted to square meters).

It will be seen that on the average territories on Mandarte Island are no more than one tenth the size of mainland territories in the East, and secondly that the same tendency to reduction in size is shown by the island populations there. The unusually high density of Mandarte Song Sparrows calls for

TABLE 28. — Territory size of Song Sparrows in different localities

Location	Number	Territory size in m²			Authority
		Min.	Max.	Mean	
Mainland, continuous area, Ohio		2000	6000	2700	Nice 1943
Mainland, lakeshore, Minnesota	4	1254	2751	1902	Suthers 1960
Islands (freshwater), Minnesota	5	—	—	2104	Beer *et al.* 1956
Island (freshwater), Minnesota	7	—	—	810	Swedberg 1957
Mandarte Island, B.C. (1961)	52	65	400	268	Tompa 1962

explanation. Although a final answer cannot yet be given, the following factors play an important role: (1) the quantity and availability of food on Mandarte throughout the year; (2) partial spatial isolation of the population; (3) complete absence of mammalian predators; (4) the scarcity of avian predators, especially during the breeding season when the island is inhabited by numbers of sea-birds.

General phenology

Song Sparrows on Mandarte Island stay on their territories throughout the year. Territorial activity is minimal during the post-nuptial moult, and again from late November to early January. Territory establishment by young males goes on throughout the winter, even though this is not always conspicuous: in mid-winter song and serious fighting are absent. Final spacing normally takes place in late February and March, but in years with a surplus of males (such as 1962) the process can be considerably delayed. In that year the unbalanced sex ratio was due to a late snow storm which resulted in the death of many females. The delay in breeding, however, cannot be attributed to bad weather conditions directly, as on other islands with low Song Sparrow densities breeding started as usual.

Nest building normally occurs during the last week of March or first half of April. During the first two seasons a substantial portion of the pairs raised three broods, the successive broods being well synchronized in the population. In 1962, mainly because of the continuous fighting, territory desertions, and shifts in territories which resulted from the unbalanced sex ratio, breeding was most irregular. Young from the first brood appeared throughout the season, even as late as July. The number of second broods was low, and there was no evidence of a successful third brood.

Clutch size

Johnston (1954) gave the average clutch size for the Song Sparrow in Oregon and Washington as 3.81. Only the first and second clutches (3.65 and 4.00 respectively) were included in this figure.

The data most applicable to the Mandarte situation are those gathered in the Vancouver-Victoria region of southwestern British Columbia, representing

the same subspecies in approximately the same climatic region. These figures (from the B.C. Nest Records Scheme) show essential agreement with the Mandarte data, as shown in Table 29.

TABLE 29. — Clutch size of Song Sparrows in southwestern British Columbia

Area	April		May		June		Total		Source
	no.	mean	no.	mean	no.	mean	no.	mean	
Mandarte	6	3.5	14	3.82	5	3.8	25	3.68	Tompa
Adjacent area (see text)	32	3.65	25	3.72	12	3.58	69	3.66	BCNRS

Fledging success

Figures on hatching rate were not obtained in sufficient quantity, but an attempt was made to estimate the fledging success. Since the conditions in 1960 and 1961 were very similar, and the number of juvenile birds at the end of breeding much the same, it is thought that fledging success was also approximately the same in these years. The 1961 minimal fledging success was 60 per cent (from eggs to fledged young), calculated from the total number of broods throughout the season, and the total number of birds fledged, the latter determined by the ringing and census program. The actual fledging success was most likely higher, since in a group of 13 nests observed in 1962 all young hatched left the nest successfully, and only three eggs (of a clutch of four) failed to hatch. It is clear that fledging success is higher on Mandarte than has been reported elsewhere (c. 36% in Ohio: Nice, 1937; and 49.3% in San Francisco Bay: Johnston, 1956).

The food supply for the nestlings has been sufficient in the past three seasons. Only one instance was observed where death of a nestling resulted from starvation. In this nest four eggs hatched one morning, and a fifth one and a half days later. The fifth young, smaller than its siblings, could apparently not compete for the food brought by the parents, and died.

Dispersion and Philopatry

Fledglings stay on the territories of the parents for two to three weeks before gaining complete independence. During this period very few die. Fledglings from the first broods are mainly cared for by the male, whilst the female is occupied starting the next one. Fledglings from the last brood are normally fed by both parents, unless one of them goes through an early moult. Fledglings entering neighbouring territories were often observed being fed by the owners of these territories.

The replacement on the territory of old birds which have perished begins as early as September, when juvenile birds have gone through their first moult. This spacing, however, is not final, and fighting continues throughout the

winter. Most young stay in loose feeding groups during the winter, shifting from one part of the island to another.

As has been discussed elsewhere (Tompa, 1962) the revival of territoriality in the autumn, once the birds have completed their moult, coincides with a pronounced emigration of a part of the juvenile surplus. Halibut Island, a small wooded islet 1.3 kilometers south of Mandarte, and with a sparse Song Sparrow population, has been reached by Mandarte emigrants each fall, and from time to time some of them even establish territories there. One Mandarte juvenile was discovered as far as six kilometers to the west, on James Island. By contrast, there is no evidence of the immigration of Song Sparrows to Mandarte, and it certainly cannot involve more than one to two per cent of the residing population. Many birds that fledge on Mandarte and leave the island during their first winter, return and attempt to establish themselves the following spring.

Once they have bred on the island the site tenacity of Mandarte Song Sparrows is very strong. The few exceptions to this rule follow. One male, which had spent the summer of 1960 unmated, in 1961 moved to a neighbouring territory whose owner had perished during the winter. In 1962 there were a few cases of territory desertion by males. The only shifts of breeding females were caused by the death of their male, the females moving to territories of unmated males. In one case a female deserted her mate, because of the continuous interference by several unmated males which completely surrounded her territory.

Summing up, Mandarte Island affords the optimum habitat for Song Sparrows in the area, and its population has been extremely high during the three seasons under consideration. Territoriality plays a vital role in adjusting the population level to the environmental conditions, which may vary slightly from year to year, and also in redressing any maladjustments in the population composition (e.g. the unbalanced sex ratio in 1962). A full analysis of the mechanisms of population regulation of the Song Sparrow is in preparation (Tompa, *Ph.D. thesis*).

Species of Changing or Uncertain Status

Phalacrocorax penicillatus, Brandt's Cormorant

Though present in summer on the British Columbia coast at least as far north as Queen Charlotte Sound (Munro and Cowan 1947: 52), there are no known nesting sites of the Brandt's Cormorant in the province (Drent and Guiguet 1961: 116). At Mandarte the species is an abundant winter visitor (adults and immatures) and scarce summer visitor (predominantly immatures), an interesting situation in view of the nearby nesting sites in the San Juan Islands of Washington.

North Rock and the cliffs of Mandarte are favoured roosts in the area, the number present through May and early June being roughly 40-70, increasing as the adults begin returning in July to a full occupancy of about 1000 birds, which may be reached by the close of August. Figure 22 shows the return of

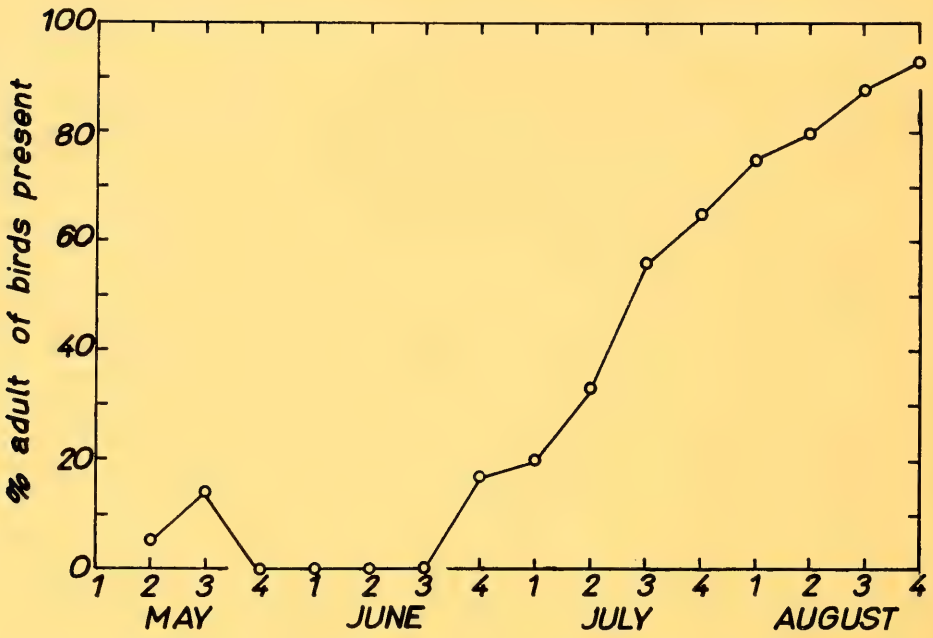

FIGURE 22. Composition of the Brandt's Cormorant roost on Mandarte Island in the course of the summer (weekly averages).

adult Brandt's Cormorant to the Mandarte roost in 1958 (aged by plumage by van Tets). The number using the roost during the winter is indicated by the following counts: 500, January 17, 1959; 800, December 29, 1959. Peak numbers are usually seen only at dusk, with less than 100 birds present by day.

Birds in immature plumage can be seen to court and build flimsy nests of grasses and algae throughout June, but up to 1962 no eggs have been laid. Kortlandt (1942) made an intensive study of Dutch colonies of *Phalacrocorax carbo*, and found that almost all one and two year old birds live in the colonies in May, displaying immature reproductive behaviour and building play nests. He found the species to start breeding at three years, though many individuals first bred at four and five years. Of interest here is that though birds usually bred in the natal colony, they often spent the immature years in other colonies, and Kortlandt gathered suggestive evidence that new colonies originate in three phases. First the cormorants use the site as a sleeping place, next immatures move in during the breeding season and go through play nesting, still returning to the natal colony when mature however, and finally the colony becomes established when birds with previous breeding experience elsewhere settle and begin to nest. We feel that the Mandarte roost of Brandt's Cormorant represents the second phase, namely use of the site as winter roost and occupation by immatures in the breeding season, and consider it likely that a nesting group will be established in the next few years.

Ardea herodias, GREAT BLUE HERON

Members of the Victoria Natural History Society are responsible for establishing the nesting of the Great Blue Heron on Mandarte. The records made by this group on their numerous excursions to Mandarte have been kindly reviewed by Mr. A. R. Davidson who supplied the following summary (*in litt.* 8 November 1961). On May 27, 1945, seven heron nests were found, two in an Arbutus, the remainder in Douglas Firs: four in one tree, one in another. One nest examined contained only broken eggshells, evidently the work of the Northwestern Crow. No herons were noted on the next two recorded trips (June 10, 1950; June 16, 1951), but on June 21, 1952 and June 27, 1953 herons flew from the trees upon arrival of the party. However, no nests were found. On July 2, 1955, no herons were noted.

Since 1957 our records indicate that the Great Blue Heron, though common in the area and nesting as close as Tsehum Harbour, has been only an occasional visitor to the island in the summer. For example: in 1959 herons were seen seven times on the island during our stay; in 1960, four times. In summary, at least seven pairs of Great Blue Herons nested on Mandarte in 1945. No herons were mentioned by Munro (last recorded visit 1936), and no nests were found in 1950 or later.

Selasphorus rufus, RUFOUS HUMMINGBIRD

The Rufous Hummingbird is a summer resident on the island, where male display flights are conspicuous in early summer and individuals have been noted to the close of August. Hummingbirds have been seen to chase Northwestern Crows, Red-winged Blackbirds and Savannah Sparrows (the latter does not breed on Mandarte). We suspect the species to nest in small numbers on Mandarte, but have not found nests or young to prove this.

DISCUSSION

Mandarte supports flourishing breeding populations of Double-crested and Pelagic Cormorant, Glaucous-winged Gull, Pigeon Guillemot, Northwestern Crow, and Song Sparrow. Strictly marginal are the other breeding species, Black Oystercatcher, Tufted Puffin, (?Rufous Hummingbird), Barn Swallow, and Red-winged Blackbird. Factors promoting the success of the first group will be mentioned here, and some general comparisons made.

The sea-birds require freedom from excessive molestation by man, freedom from land predators, and suitable nesting sites within reach of an adequate food supply. These conditions are all met at Mandarte. Through protection human disturbance has been kept below the critical level, and mammalian predators are absent. As far as nesting sites are concerned, the steep irregular southwest facing shore offers extensive ledges for the cormorants, the scarcity of vegetation makes much of the island suitable for gulls, and the broken nature of the rocky shores provide abundant nesting holes for the guillemots.

The data presented on breeding seasons serve as a description, but are inadequate for analysis of either the environmental timers or of the possible ecological advantage conferred upon the species at that particular time (e.g.

superabundance of the food required for the nestlings). It is hoped that this report will stimulate continued observation to attack these problems.

TABLE 30. — Nesting success in Mandarte sea-birds

Number per pair per season of:	Double-crested Cormorant	Pelagic Cormorant	Glaucous-winged Gull	Pigeon Guillemot
eggs laid	4.1	3.8	2.6	1.9
chicks hatched	2.5 (60%)	2.5 (60%)	1.6 (60%)	1.2 (62%)
young fledged	2.4 (95%)	2.0 (80%)	0.9 (56%)	1.1 (90%)
Over-all success	57%	53%	34%	56%

Turning now to nesting success, Table 30 shows that hatching success is similar for all of the "successful" sea-birds on Mandarte, at about 60 per cent. It appears that "addling", i.e. failure of eggs to hatch due to infertility or embryonic death, is roughly the same in these species (21%, 18%, 15%, 21% of all eggs laid, in the order listed in the table), the remainder of the egg loss being accounted for largely by crow predation. The data on egg predation suggest that the presence of the adult at the nest is the only effective mode of protection. The easily panicked cormorants suffer a far higher loss than the more steadfast gulls, and of particular significance is the situation in the hole-nesting guillemot, where egg loss was as heavy as in the gulls, and centred in the first few days of incubation, before the parents attend the egg continuously.

The cormorants and the Pigeon Guillemot have comparable over-all success of better than 50 per cent of all eggs laid resulting in fledged young, and it will be noticed that practically all loss occurs in the egg stage. The Glaucous-winged Gull is radically different, here losses in the chick stage equal or even exceed losses of eggs. The primary reason for this difference lies in the mobility of the gull chicks and the trait of the adults to attack strange chicks that stray onto their territory. In the dense Mandarte colony this accounts for most of the chick mortality (as was the case in the Herring Gull studies of Paynter and Paludan).

Considering now the successful passerines, the dense nesting population of the Northwestern Crow is doubtless related to exploitation of the eggs and young of the sea-birds. Calculations from the figures given earlier indicate that in the period under review, for the whole Mandarte colony in one season, crows took about 150 eggs of the Double-crested Cormorant, 450 eggs of Pelagic Cormorant, 700 eggs of the Glaucous-winged Gull, and 30 of the Pigeon Guillemot. This is a total exceeding 1000 eggs, and it may be assumed that the resident 25 pair take the major share. Further, many small chicks are taken, and an additional food source are the fish scraps found in abundance in the cormorant colonies during the chick stage. The Northwestern Crow on Mandarte has thus specialized in plundering the sea-birds as has been reported at other colonies (e.g. Heath, 1915), even to the extent of openly attacking incubating Pelagic Cormorants (compare Nordberg (1950) on *Corvus corone* molesting incubating Eiders).

The factors promoting the success of the Song Sparrow on Mandarte are more complex, and discussion is deferred until completion of the population study.

SUMMARY

Distribution and numbers of the ten species of birds presently breeding on Mandarte are described on the basis of six summers' residence on the island. Statistics on breeding season, nesting success and related topics are presented for *Phalacrocorax auritus*, *P. pelagicus*, *Haematopus bachmani*, *Larus glaucescens*, *Cepphus columba*, *Corvus caurinus*, and *Melospiza melodia*.

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THE *RUSTY* COLOUR PHASE OF THE CANADIAN TOAD, *Bufo hemiophrys*

FRANCIS R. COOK
National Museum of Canada, Ottawa, Ontario

THE DORSAL GROUND COLOUR of the Canadian Toad, *Bufo hemiophrys*, has been described as "brown" (Dickerson, 1908: 98), "brownish or greenish" (Wright and Wright, 1933: 66, 1949: 180; Conant, 1958: 268) or "greenish or brownish" (Stebbins, 1951: 263, 1954: 108). During studies of the herpetofauna of the Canadian prairie provinces 3,051 live adult and juvenile toads of this species have been examined. In the majority the dorsal ground colour varied from muddy brown to light grey with greenish shades in some individuals.

However, 50 specimens have been collected which differ markedly from published accounts. In these the dorsal ground colour was reddish, varying from a light rust-red to reddish brown, distinct from the usual brown variations which occur in this species. In all aspects of pattern the contrast was the same

TABLE 1.—Collections of *Bufo hemiophrys* in which the *rusty* phase occurred.

NMC Cat. No.	Locality	Date	Total	*Rusty*	% *Rusty*
	SASKATCHEWAN				
6276	White Fox, 2.8 mi. W. on Hwy. 55	8 July 1962	21	2	9.5
	MANITOBA				
6393	Flin Flon, 14.2 mi. SE. on Hwy. 10	23 July 1962	2	1	50.0
4862	Mafeking, 0.8 mi. N. on Hwy. 10	18 Aug. 1960	6	2	33.3
4859	Birch River, 4.9 mi. S. on Hwy. 10	18 Aug. 1960	41	8	19.5
4880	Benito, 3.8 mi. N. on Hwy. 83	21 Aug. 1960	2	1	50.0
4873	Camperville, 11.4 mi. W. on Hwy. 20	19 Aug. 1960	23	8	34.8
4838	Winnipegosis, 16.2 mi. NW. on Hwy. 20	14 Aug. 1960	10	2	20.0
*	Ethelbert, 13.0-16.1 mi. N. on Hwy. 10	12–13 Aug. 1960	121	19	15.7
4500	Steinbach, 26.3 mi. SE. on Hwy. 12	3 July 1960	109	7	6.4
			335	50	11.9

*6 collections (4809 (35), 4812 (9), 4814 (3), 4819 (9), 4829 (10), 4832 (49) which contained one or more *rusty* individuals, and 4 collections (4826 (3), 4820 (1), 4817 (2), 4811 (3)) which did not contain *rusty* individuals, all taken from the same continuous area of road on the same night, are lumped together here.

as in typical examples. There were usually dark patches in which the warts, although lighter than the patch, were darker than the ground colour. The vertebral stripe and lateral streaks were light and the underside was dirty white or slightly yellowish white with a variable amount of dark flecking or spotting. Structural characters such as the cranial crests or boss varied as in typical individuals. As this colour seems to be distinct from the usual spectrum of variation in *Bufo hemiophrys* it is designated as the *rusty* colour phase.

The 3,051 specimens seen alive from Canada are contained in 216 collections. Fourteen of these collections have specimens designated as "red" or "reddish" in field notes taken before they were preserved and are assigned to the *rusty* phase. After a period of preservation in formalin of 1½ or more years, most *rusty* specimens are indistinguishable from other colour variations as all fade to more or less dull greyish. Figure 1 shows the localities where this phase has been collected. Only nine localities are plotted for the 14 collections as six collections taken August 12, 1960, 13.0-16.1 miles north of Hwy. 10 of Ethelbert, Manitoba, are represented by the same circle. In addition, all collections of 20 or more *B. hemiophrys* taken in 1959-63 which did not contain this phase are also mapped. Over 150 smaller collections examined which also lacked the *rusty* phase are not shown. The apparent gap between the southeastern collection in which this phase was present and those northwest of it is probably real. Large collections from two intermediate localities did not contain *rusty* toads. One, taken 2.2 miles north and 0.5 miles east of St. François Xavier (= 13 miles west of Winnipeg) totals 266 individuals (NMC 4515, 4517, 4520, 5333, 5334) and the other, from Delta at the southern tip of Lake Manitoba contains 721 (NMC 4525, 5388, 5390, 6052). Although the

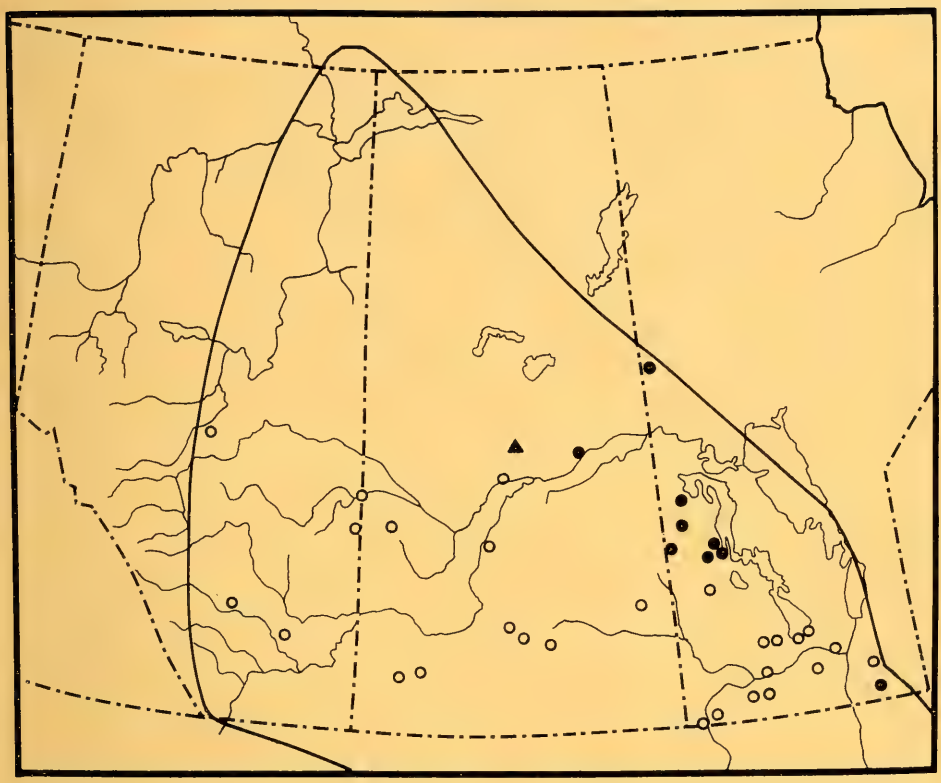

FIGURE 1. The occurrence of the *rusty* phase in collections of *Bufo hemiophrys* from Canadian prairie provinces. Solid circles represent collections which contained *rusty* individuals. Hollow circles represent collections of 20 or more specimens which did not contain *rusty* individuals. The solid triangle is Emma Lake where the *rusty* phase was reported by D. J. Buckle. The solid line indicates the approximate known limit of *Bufo hemiophrys* modified from previously published maps on the basis of the author's unpublished data.

rusty phase occurs near the eastern edge of the range of *B. hemiophrys* it may not be present at the edge. It was not found among 34 specimens (NMC 5364) taken 22.6 miles west on Hwy. 1 of the junction of Hwys. 1 and 11 (= 32 miles southeast of Winnipeg). This locality is within a few miles of the eastern limit for the species where it contacts the range of *Bufo americanus*.

In Table 1 the collections which contained *rusty* toads are listed with the percentage of this phase in each. As in Figure 1, collections from near Ethelbert are lumped. This percentage of *rusty* specimens in collections of more than two individuals varies from 34.8 to 15.7% within the Manitoba area east of Lake Winnipegosis, with the outlying occurrences, White Fox and Steinbach, containing 9.5 and 6.4% respectively. All collections were random with no conscious attempt to select the *rusty* phase. No correlation with soil colour or other habitat factor was noted for *rusty* individuals that would favour selection for this phase in nature.

In snout-vent length *rusty* specimens measured 16 to 57 mm with a mean of 34.8 mm. All large collections containing this phase showed a more or less typical bell curve of distribution when size and numbers were plotted. *Rusty* toads occurred only in those size groups which were most plentiful in a given collection. The minimum and maximum snout-vent measurements of all toads in collections which contained *rusty* individuals were 13 and 69 mm. The maximum length for all Canadian *Bufo hemiophrys* examined is 85 mm for males and 91 mm for females. (The latter betters by slightly more than $\frac{1}{4}$ inch the maximum given by Conant, 1958: 265.) It is likely that the apparent failure of *rusty* individuals to approach the maximum size is due to the lack of any large adults in collections from areas where they occur, rather than a loss of the colour with age, or differential selection between adults and immatures. No collections have been made from breeding aggregations in these areas and this accounts for the paucity of large individuals from them. There is no correlation between sex and the *rusty* phase as the 50 specimens were identified by dissection as 24 males and 26 females.

D. J. Buckle (PC: February 7, 1964) has reported the occurrence of "red" specimens of *B. hemiophrys* which presumably were the *rusty* phase from Emma Lake, 25 miles north of Prince Albert, Saskatchewan. This report, the westernmost for the *rusty* phase, is indicated on Figure 1 by a solid triangle. Of a series of 99 specimens measuring 19-25 mm collected July 23 and 29, 1962, 26% were classified as the *rusty* phase by Buckle.

A presumably allopatric species, *Bufo a. americanus*, may exhibit brownish, greenish, yellowish or reddish coloration in eastern Manitoba, based on examination of 197 specimens. The reddish colour of *B. americanus* and the *rusty* phase of *B. hemiophrys* are similar. It is possible that past or present gene exchange between *B. americanus* and *B. hemiophrys* could account for the presence of the *rusty* phase in the latter. If so, however, one might expect other variations of *B. americanus*, such as the yellowish ground colour, to occur also, which is not the case. In addition, as noted previously a collection of *B. hemiophrys* a few miles from the western limit of *B. americanus* did not contain *rusty* individuals. Neither does it appear likely that *rusty* is a primitive coloration in *B. hemiophrys*, relict at the periphery of the species' range. Available information indicates that it occurs over a fairly large region, and may be absent at the range periphery. However, more collections are needed before this possibility can be discarded. The most plausible explanation of the origin of this *rusty* phase is the survival of mutations originating at or near the area where the phase now occurs. The present disjunct range of the *rusty* phase could be due to historical reasons or because mutations have occurred and survived independently in the geographically separated populations. No factors are presently known which would promote or prevent *rusty* individuals competing equally as well as other variations.

The common name Canadian Toad is used here in preference to "Dakota Toad" which was recommended in the list of common names for North American amphibians and reptiles proposed by the American Society of Ichthyologists and Herpetologists (Committee, 1956: 176). Dakota Toad seems to have been originated by Schmidt (1953: 67) and presumably was chosen because the

type specimens of the species were collected in what is now North Dakota. However, the name Canadian Toad has had extensive usage (Wright and Wright, 1933, 1949; Stebbins, 1951, 1954) prior to Schmidt. In addition it designates the country which contains the major portion of the species range. It is less restrictive than Dakota Toad, or other names previously coined, Manitoba Toad and Winnipeg Toad.

Acknowledgement is due to J. R. Otterdahl (1959), R. A. Henry (1960), M. G. Foster (1961) and C. Bruce Powell (1962, 1963) who assisted in field work in the years noted, to Joyce C. Cook who prepared the map, and to D. J. Buckle who contributed a report of the *rusty* phase.

SUMMARY

Among 3,051 specimens in 216 collections of the Canadian Toad, *Bufo hemiophrys*, examined alive, 50 specimens (contained in 14 of the collections) were an unreported colour variation for this species. This has been designated as the *rusty* phase and has a ground colour of light rust-red to reddish brown. Most *rusty* specimens have been collected in the area between Lake Winnipegosis and the western Manitoba border. They have been collected in southeastern Manitoba, and reported in central Saskatchewan at Emma Lake. The percentage of *rusty* individuals in populations in which they occur varied from 6.4 to 34.8% of collections containing more than two specimens. They measured 16 to 57 mm. The 50 *rusty* specimens were determined by dissection to be 24 males and 26 females. The origin of this phase was probably by the survival of mutations in the area where they are now found.

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NOTES

Two Helpful Uses of "Terylene" for Biologists

Justice and Schaldach (Journal of Mammalogy, 39(1):158) outlined the difficulties encountered in obtaining fluffy long-staple cotton for filling skins of small mammals, and their experience and satisfaction with "Dacron", a synthetic fiber manufactured by Du Pont.

A similar synthetic fiber manufactured by Canadian Industries Limited under the trade name "Terylene" fiberfill is available in Canada. I have used this material for filling study skins of birds and small mammals, and found it superior to cotton because of Terylene's long fiber length and high resilience.

Terylene has also proven more satisfactory than cotton for use as nesting material in live traps for small mammals. Some small mammals, particularly *Microtus pennsylvanicus*, urinate extensively when caught. As a result, cotton is trampled down into a soggy mat when used for nesting material in sheet metal live traps. Similar results occur when seepage from heavy rains dampens the floor of the traps. Terylene, through its high resilience and low water absorption, helps keep small mammals dry and warm by preventing contact with the wet floor of the trap. I have used Terylene fiberfill in live traps near Hinton, Alberta. With captures ranging between 104 and 158 small mammals daily during an eight-day period in August 1961, losses were only between 2.9 and 6.1 per cent, and those were primarily among shrews.

I recommend Terylene for use as nest material in live traps for small mammals as well as for filling museum skins.

Andrew Radvanyi

Canadian Wildlife Service
742 Federal Building
Edmonton, Alberta
27 April 1964

A Range Extension for the Wood Frog in Northeastern Saskatchewan

Incidental to ornithological studies in northeastern Saskatchewan in the summer of 1963, the senior author obtained nine specimens of the Wood Frog, *Rana sylvatica*. These were collected July 14 to 16 at Hasbala Lake, 59° 58′ N, 102° 03′W. They have been deposited in the National Museum of Canada and catalogued as NMC 7682.

Although distribution maps in Conant (1958, *A Field Guide to Reptiles and Amphibians*, p. 352) and Martof and Humphries (1959, American Midland Naturalist 61 (2): 350-389) include all of northern Saskatchewan within the range of the Wood Frog, the most northerly locality for the eastern part of the province previously authenticated by specimens was Wallaston (= Wollaston) Lake. This was cited by Logier and Toner (1961, *A Check List of the Amphibians and Reptiles of Canada and Alaska*, p. 43) on the authority of H. Beck. Beck's communication was based on two collections at the University of Saskatchewan, Saskatoon, taken in August 1956 from Wollaston Lake: Welcome Bay (A-173, -174, -175) and Compulsion Bay (A-177, -178, 179). Welcome Bay is not given in the Saskatchewan volume of the *Gazetter of Canada* (1957) but Compulsion Bay is listed as 57°47′N, 103°16′W. This is at the southern end of Wollaston Lake, approximately 145 miles south of Hasbala Lake.

Hasbala Lake is within the Northwestern Section of the Boreal Forest, a region which is described generally as "open subarctic woodland" or "open lichen-woodland" (Rowe, 1959, *Forest regions of Canada*). The Transition Section in Saskatchewan has been related to

the Hudsonian Life Zone (e.g., see Nero, 1963, *Birds of the Lake Athabasca region, Saskatchewan.* Special Publication No. 5, Saskatchewan Natural History Society, Regina). A camp was established on the southwest end of Hasbala Lake, five miles southwest of the northeast boundary corner and two and one-half miles west of the Manitoba border. Although this area consisted predominantly of open black spruce forest, the best available campsite was found on a low esker ridge in an old burn. The immediate environs were chiefly charred boles of spruce and pine with scattered green alder and birch clumps and a few pine seedlings. In wet places lichens, mosses, willows, and other bushy or herbaceous plants grew abundantly, but the burned area was otherwise rather bleak. Certain bird species, e.g., Gray-cheeked Thrush, White-crowned Sparrow, and Harris' Sparrow, seemed especially attracted to the burned area. Black flies and especially horse or bulldog flies were unusually abundant at this site.

A few frogs were found at the camp in a wet sphagnum bog adjacent to a narrow ice-formed ridge along the edge of the lake. In a depression behind the camp there was a dry, heavily-grassed "meadow" and a well-established pond which attracted an even larger number of frogs. Large willow clumps were scattered abundantly throughout the meadow and around the pond. Numerous holes in the ground, apparently formed when this meadow was a wet bog, were half-hidden by the tall grass and made walking difficult. At least one Wood Frog was seen in the muskeg as gear was being unloaded on the shore on July 9, the day of arrival. In the evening of July 14 four frogs were collected in the meadow; two others were taken on July 15, and three on July 16, either in the meadow or in front of the camp. On wet days a few frogs were encountered out in the open on the scorched, barren surface of the ridge. On one or two occasions Wood Frogs were seen in wet situations inland, but the largest number was noted in the grassy meadow behind the camp. On the whole, frogs were uncommon in the area, and there were numerous suitable situations where none was encountered. No other species of herptiles were found.

Of the nine specimens, six were adults and measured, after preservation, 46, 47 (2), 48 and 50(2) mm snout-vent, average 48 mm. Their tibia/body length ratios varied from .417 to .457, average .433. The four largest specimens were females with their ovaries distended with eggs. The three immatures measured 35, 28 and 23 mm. Only two specimens had a middorsal white stripe. In their detailed maps of variation in *Rana sylvatica*, Martof and Humphries (1959) included populations in northeastern Saskatchewan within regions where the adults averaged less than 40 mm in body length (p. 358) and more than half the population had a middorsal white stripe (p. 367). They noted, however, (p. 355) that the maps "do not show local conditions with the exactitude one would like to have". The Hasbala Lake specimens do agree with the tibia/body length ratio "less than .475" in which northern Saskatchewan Wood Frogs are included (p. 363).

ROBERT W. NERO
FRANCIS R. COOK

Natural Sciences Division
University of Saskatchewan Regina Campus
Regina, Saskatchewan, and
National Museum of Canada,
Ottawa, Ontario
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MRS. G. R. HANES

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